Devoted to the Generation, Distribution and Utilization of Energy

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Rainbow Falls, at Head of Lake Chelan, Washington, in Which District Is Located Sufficient Energy to Electrify a Transcontinental Railroad.

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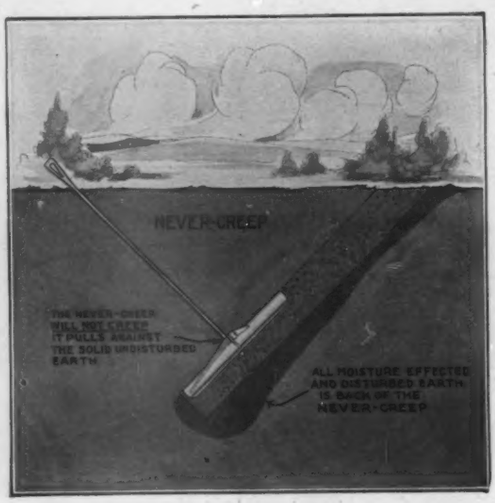
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VOLUME XXXVIII SAN FRANCISCO, FEBRUARY 1, 1917 NUMBER 3

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General View of Folsom Dam and Headgates, Upper Canal

A NEW RECORD FOR LOW HEAD DEVELOPMENT

BY RUDOLPH W. VAN NORDEN, Mem. A. S. C. E.; Fel. A. I. E. E.

(Here is a description of an unusual harnessing of waterpower, constituting as it does a new record for low head hydroelectric development. Historically speaking the original Folsom installation from this same canal source was the pioneer in power transmission. The new plant recently designed and installed by the author of this article under authority of the State Department of Engineering, is intensely interesting in that turbines are so designed as to efficiently handle hydraulic heads of but eight feet. The installation was built by the labor of the convicts at the state institution, which proved efficient and free from accident.—The Editor.)

One of the Operators on the Job.

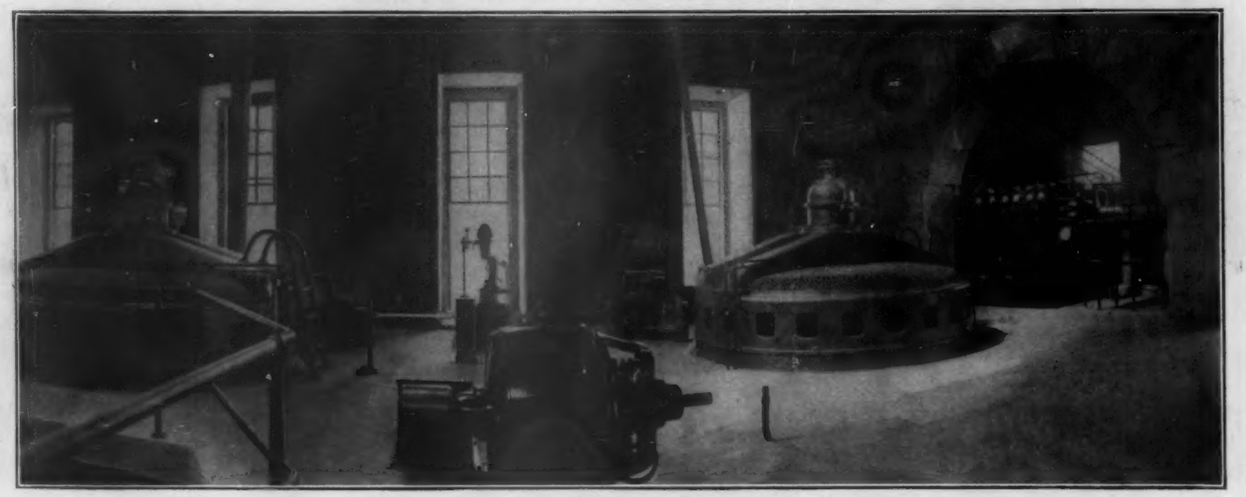
ONE of the two California State Prisons is situated two miles east of Folsom on the south side of the American River, a tributary to the Sacramento and having its source among the high altitudes of the Sierra Nevada range. The prison nestles in the foothills which meet the valley but a short distance to the west.

In 1866 a project was inaugurated to develop a manufacturing center at the town of Folsom, utilizing the power of the river, due to its fall between the town and the site of the prison, and work was commenced on a dam in the canyon of the river at the prison site. Twenty years of unsuccessful negotiations passed before a final arrangement was made to proceed with the work by convict labor. In the meantime the state had received title to the land upon which the prison now stands, together with the surrounding farm, also a right to use of a fall in the canal of 7.33 ft., to produce power for uses at the prison. The state then erected a power house across the canal in which were placed six vertical turbines of 75 h.p. each, the shafts of these driving a horizontal jack-shaft through bevel gears. From this jack-shaft were driven by rope drives, a two-cylinder single stage air compressor of slow speed and great size, having a nominal capacity of 2000 cu. ft. of free air per minute; also an horizontal 3-throw plunger pump with a capacity of 960 cu. ft. per min. operating at 10 r.p.m. This also was a huge affair. A machine shop and ice-plant were also driven from this jack-shaft.

The prison plant was built in 1891, and the construction of the canal was continued to the town of Folsom. In 1893 the plan of Horatio P. Livermore, who, with his brother Charles had been the moving spirits in the proposed power development since its inception, to generate electric power and transmit it to Sacramento, began to take form. After many trials and vicisitudes the electric plant at Folsom was completed and the famous Folsom to Sacramento transmission, the pioneer of power transmission systems in America commenced operation on July 7, 1895. The water to drive this plant, after leaving the dam, follows the canal for a quarter of a mile, then passing through the turbines at the prison plant, continues for a distance of 1½ miles to the Folsom plant, now one of the fourteen hydroelectric generating plants of the Pacific Gas & Electric Company. In 1906, two of the vertical turbines in the prison powerhouse were removed and in their place was set a double horizontal turbine having a nominal rating of 150 h.p. In 1915 the State Legislature made an appropriation for the construction of a new hydroelectric plant at the prison of sufficient capacity for the needs of the prison for many years.

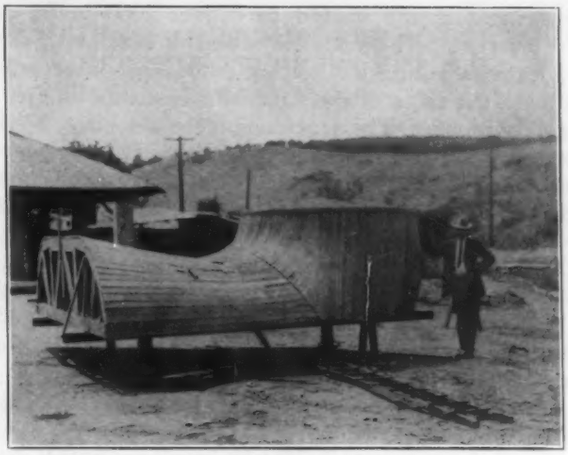
The problem presented in the design of a power plant was somewhat difficult, due to the many severe controlling conditions where the limits in type and capacity were more or less interdependent and all closely circumscribed by these controlling conditions. The use of the old turbines and jack-shaft was out of the question, for besides being worn out and sadly inefficient, the capacities were too small. The slow-speed air compressor was in much the same class, except that its capacity was much too great for the needs of the prison while the triplex pump was in the last stages of its usefulness and archaic in its antiquity. Furthermore it would not supply sufficient water for the uses of the prison.

During about nine months in the year, there is sufficient water in the American River to operate the Pacific Gas & Electric Company's plant at the end of the canal line, which is more than enough for the present and probably the future needs of the prison. During the remainder of the year, the river's flow dwindles until in most years it will not exceed 100 cu. ft. per second. With a canal full of water flowing, and the water level above the prison plant at the spillway line, the difference in water level above and below the prison powerhouse is actually 8.5 ft. During the period of low water flow, while the canal above the prison powerhouse may be kept full, the tail water level falls until the difference in head may be as great as 12 ft. In other words, the variation in head on the prison turbines may be almost as great as 50 per cent of the normal head. It was found that the probable uses of the prison would require a plant which would deliver continuously not less than 400 h.p. The old granite flumes which extend underneath the powerhouse and in each of which was placed originally, one of the 75 h.p. turbines, were found to have a flow capacity for about 300 sec. ft. within the limits of good practice for maximum allowable velocity. A turbine placed in each of two of these flumes would give together, the required power. To design a turbine to operate under a head, which might be as low as 8 ft. and handle such a quantity of water meant a structure of extremely low speed and a diameter too great to be placed in the flume and still leave space for good water entry. The lower the speed adopted meant the greater the weight and diameter of the generator if direct connected. In any case a runner design for high specific speed and consequently great water capacity was essential. After equating all of these conditions, it was decided to adopt a runner of 51 in. mean diameter, operating at 100 r.p.m., having a nominal shaft horsepower of 215, while operating under 8.5 ft. head with a flow of 285 sec. ft. The design of the turbine was such that while the power output increases more than 50 per cent when the head is increased to 12 ft., the efficiency also increases several per cent. This works in nicely with the plan of operation, for, when the head is low, there is ample water and the slightly lower efficiency is not a detriment, but when the head is high, the quantity of water is limited and the greater the amount of power available from the water flowing, the less of standby power there is to be purchased. For during the three months of low water flow, it is not expected that sufficient power can be generated for the prison uses and the standby service must be utilized.



Panoramic View of Power Plant

One of the Turbine Runners; Weight 4 Tons



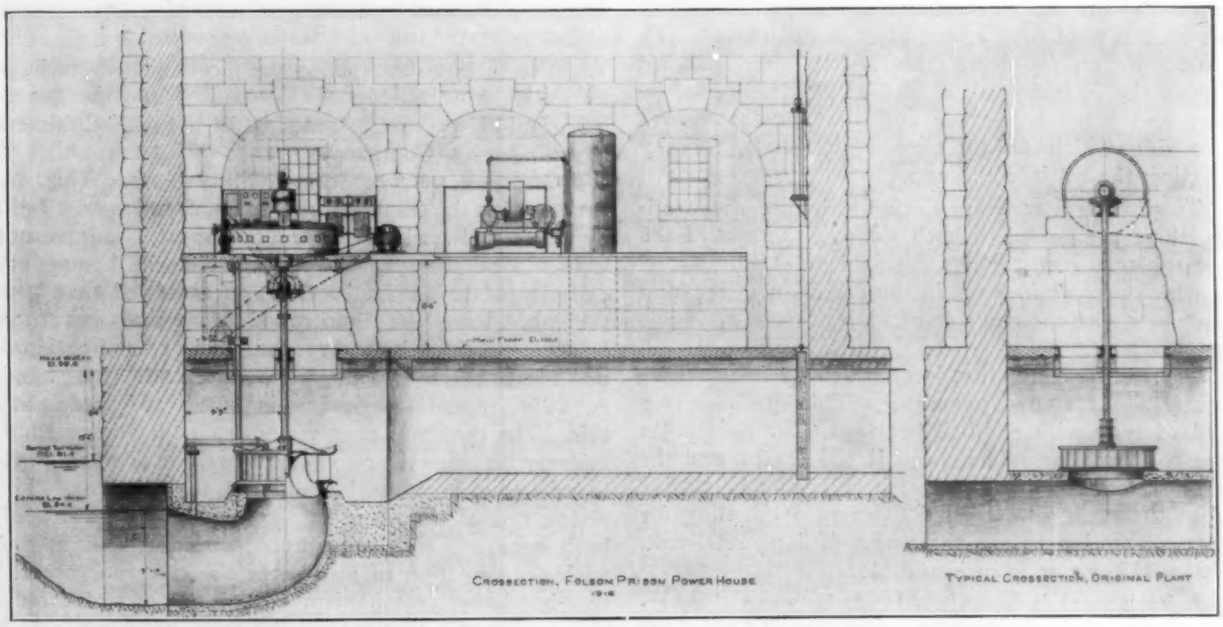
Form for Upper Half of Draft Tube

Under normal operating conditions the turbine runners are lower than the surface level of the tail water, hence the greatest care was exercised in the design of the draft tubes which are formed in concrete.

All idea of mechanical drives for compressor pumps and ice-machine was abandoned, because, in the first place, new machinery was essential to maintain the prison service, the old apparatus being long past the period of dependable operation, and secondly because with modern machinery, any mechanical drive would have been awkward, expensive and inefficient. Hence the determination to drive all machinery by induction motors.

The plant as finally determined and built consists of two vertical main generating units. The main powerhouse floor is an 8 in. slab of reinforced concrete placed at a level 9 ft. above the main floor of the building. This was necessary, partly to accommodate a jack-shaft between the two turbine shafts and partly to provide head room between the main floor and the generator floor. The generators are necessarily machines of special design because of the low speed and unusual small capacity for machines of this speed. The stator is of a conventional type for a vertical machine and is supported on a castiron ring which rests on the floor slab. The winding is of the ordinary distributed type. The rotor has a castiron spider which, beside being held by two keys to the shaft, is split on one side and has two cinch bolts so that by no possibility can the spider slip down on the shaft. The 72 pole pieces are bolted to the face of the spider rim. The rim is heavier than necessary for required strength, this being done to add weight, the moment of inertia being required to be 80,000 ft.-lb. for purposes of proper regulation, or, in other words, to give added fly-wheel effect. The generator shaft extends upward to provide for the suspension, or thrust bearing.

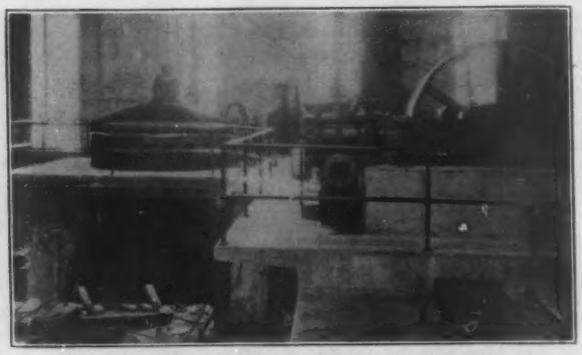
Protection on either side of the yoke to the windings and to obviate the danger of a person falling into the moving spider is had by heavy wire nettings which have sufficient stiffness to hold the weight of a man. Neat iron steps make a safe passageway for the operator when attending the brushes or thrust-bearing.



The generators are wound to deliver 2300 volts, 3-phase current. The nominal rating is 200 k.v.a., the specifications calling for heating guarantees in accordance with the rules of the American Institute of Electrical Engineers. The machines were also tested for a runaway speed of 200 r.p.m., or 100 per cent overspeed, which is a condition of runaway speed that might occur when the turbines were operating at a maximum head of 12 ft.

The generator shaft extends 6 ft. below the generator floor level terminating in a forged flange and to this is bolted by ten 1⅛ in. bolts, the similar forged flange of the turbine shaft. Both of these shafts are 7 in. diameter.

The total weight carried by the thrust bearing is 19,000 lb., to which must be added the hydraulic thrust of the runner of 6000 lb., making 25,000 lb.



Air Compressor, Power Plant in Background

total load. This is divided as follows: rotor, 7400 lb.; runner 8000 lb., shafting 3600 lb., thrust 6000 lb.

The two vertical steady bearings are oiled from a glass drip cup having capacity for 0.6 gal. lubricating oil. The oil passes down through the bearing and the drip is caught in an annular castiron cup and drains through a pipe, fitted with a sight-gauge, which is carried around the rotor to the upper side of the lower bearing, passing through this, it is again caught in a similar annular cup and drained into a tank, from whence it is used over again, after being filtered. To prevent the oil following the shaft, after passing through the bearings, there is provided between the lower end of each bearing and the annular cup, a baffle ring which solidly clamps the shaft, thereby deflecting the oil into the cup.

To provide a constant draft of air into the windings, there are bolted to both sides of the rim of the rotor spider, directly under the field poles, sheet-steel fins which project forward in the direction of rotation at an angle with the rim side of 50 deg., these acting as fans.

Current for excitation is provided by one 30 kw., 125-volt shunt wound generator. This machine is a standard type with end-bell bearings, four field poles and two interpoles. The speed is 1200 r.p.m. and the shaft at one end is equipped with pulley for belt drive and at the other is extended to carry a coupling for direct connection to the shaft of a 40 h.p., 2300-volt, 3-phase, 1150 r.p.m. induction motor.

A horizontal jack-shaft extends between the vertical shafts of the two turbines, its speed being 300 r.p.m. Upon each end of the jack-shaft is mounted a rawhide bevel gear and these are driven from the turbine shafts by castiron bevel gears having split hubs being mounted on the turbine shafts. As it is intended to drive the jack-shaft from either turbine, but not from both at one time, there are two sliding jaw clutches operated by levers which extend above the generator floor. This arrangement divides the jack-shaft into three sections, there being two bearings to each section, or six in all. In the design of the jaw clutches, an interesting problem arose. In throwing out one clutch in order to engage the other, with both turbines running, so that the central part of the jack-shaft would not lose its driving power and thus stop turning, it must be possible to momentarily engage the idle clutch, before disengaging the running clutch. The generators operating in synchronism, there are 36 points of relative position between the two rotors, any one of which relative positions may take place when the machines are synchronized. As the bevel gears have a ratio of 3:1, there are therefore $36 \div 3 = 12$ positions in a jaw clutch when the two halves of the clutch might engage. In order then, that the incoming jaw clutch may always be in a position to engage, the jaw clutches are built with 12 radial jaws.

The object of the jack-shaft was to furnish by belt drives the power to drive the exciter, the oil pump furnishing oil under pressure to operate the governor and to drive the governor head. Two exciters could have been used, each connected to one turbine shaft, necessitating a motor drive for the governor pump and two governors. The added complication and cost were not considered justified for the following reasons. In case of belt or exciter failure, one of the more remote exigencies, the induction motor is available to drive the exciter, and if necessary, this power may be transmitted back through the exciter driving belt to drive the jack-shaft and through it the oil-pump and governor head. This induction motor may be supplied with current, either from the station bus, or from the standby service which is always available. In case of further emergency, the standby service may be instantly thrown onto the station bus.

The turbines and jack-shaft mechanism were built by the S. Morgan Smith Company, while the generators and exciters were furnished by the Allis-Chalmers Manufacturing Company.

One governor controls both turbines. This, together with the hand regulating mechanism was built by the Woodward Governor Company. The governor with full oil pressure of 200 lb. per sq. in. has a duty capacity of 10,000 ft. lb. It is so arranged that both turbines may be controlled by the governor, or one turbine by governor and one by hand, or the reverse connection, or both by hand. A very ingenious device is used to accomplish this. The governor proper stands on the station floor, midway between the two generators, the operating cylinder being horizontal and close to the floor. The piston rod of the operating cylinder extends through both heads. Close to either generator, and in line with the direction of motion of the governor are the two handwheel mechanisms which are mounted on a cast iron frame that carries the cross-head into which

the piston rod is fastened, an arm of this frame which is flush with the floor carries at its extremity, a ball thrust bearing and passing down through the arm and supported by the thrust bearing is the rotating gate shaft which operates the turbine gates through push and pull rods at the lower end of this shaft. Above the thrust bearing and keyed to the gate shaft is a bell crank and this is operated through two links from the cross-head. The handwheel is on top. Its vertical shaft carries a spur gear which engages a pinion for the purpose of a gear motion reduction. The pinion shaft carries another pinion which engages a rack on the back of the cross-head. The hand wheel rigging is contained in a housing integral with the main frame, but is mounted on an eccentric which is moved by a lever fitted with a hand pall. By this means the handwheel mechanism may be thrown out of gear in reference with the cross-head. On the handwheel shaft is a brake operated with a small crank. The piston passes through the cross-head freely, but engages the cross-head by means of a spring bolt operated by a swinging handle. While governing, the spring bolt is in and the handwheel mechanism by means of the eccentric is entirely out of gear. When operating by hand, the pin is pulled out and the eccentric thrown in and the brake is used to hold the handwheel where desired. The turbine gates are designed to be so balanced as to have an opening tendency up to 0.4 load and a closing tendency above this point. While the gates and mechanism are heavy, one man can handle the gates without difficulty, while the governor moves them easily with an oil pressure as low as 60 lb.

There is a four-panel black slate switchboard furnished by the General Electric Company, fitted with all necessary indicating and recording instruments for two generators, three outgoing feeder circuits and one incoming 2300-volt, 3-phase standby service supplied from the power station of the Pacific Gas & Electric Company, located at the lower end of the canal. There are also three motor starter panels, one of which controls a 75 h.p. induction motor which drives the pumps supplying the prison water system, one controls a 100 h.p. motor which drives an air compressor, and the third will control the 40 h.p. motor used as reserve drive for the exciter.

The air compressor is mounted on an extension of the generator floor and is supported over one end of the massive stone foundation which originally carried the old air-compressor. This compressor is the "Imperial," high speed two-stage type furnished by the Ingersoll-Rand Company, the displacement capacity is 600 cu. ft. free air per minute, at a pressure of 80 lb. per sq. in.

Although electric current contributes to the cause of only a small number (8%) of the accidents in the electrical industry, it causes the largest number of serious and fatal accidents to employes and, therefore, this cause is worthy of the first consideration. All employes whose duties require them to work about electrical lines or equipment should use all of the safety appliances provided, and should take every possible precaution to prevent electrical contact.

OZONE FOR THE CHILDREN—I. OR ENGINEERING TWISTERS RETOLD.

Said he, "Immediately upon graduation I started to run down a job. Having in vain exhausted my supply of local acquaintanceship along engineering lines, I next decided to tackle the great handlers of electrical machinery, so I went to the General Electric and having told them what experience I had previously had in electrical installation, the manager of the local office offered me a position at a salary of $1000 per annum with an annual increase of $200, operative at the end of the first year. Having been given 24 hours in which to return an acceptance or rejection, I then turned to the Westinghouse Company who offered to give me $1000 per annum with an increase of only $100 per annum, operative, however, every six months in installments of $50 beginning at the end of the first six months."

Everybody at the table began to show signs of intelligence looking to the conclusion of his story by assuming of course that he accepted the first offer without delay.

At this moment, however, the young engineer said: "So, of course I accepted the last offer, which proved to be better than the first by $50 per annum for every year of my life."

This is seen to be the case by a detailed analysis as follows:

First Offer.		Second Offer.	
1st 6 months	$ 500	1st 6 months	$ 500
2d 6 months	500	2d 6 months	550
Salary 1st year	$1000	Salary 1st year	$1050
2d year, 1st 6 months	$ 600	1st 6 months	600
2d year, 2d 6 months	600	2d 6 months	650
Salary 2d year	$1200	Salary 2d year	$1250

The reason for this is seen to be that the second proposition is in reality a compound increase every six months and although at an annual increase of only $100, by compounding every six months, it exceeds an increase of $200 per annum on the annual basis.

POLE SETTING IN SAND.

A novel and effective means has been found for digging holes for the poles of the new transmission line which the Southern Sierras Power Company is building across the desert from El Centro, Cal., to Yuma, Ariz. The sand is so fine and dry that it runs almost like water. To obviate the difficulties of digging under such conditions the engineers of the company have devised a collapsible cone, which tends to sink into the ground by the weight of the sand and at the same time keeps the sand out.

A frustrum of a cone in about the proportions of an 18 in. top, 36 in. base and 72 in. height, is made of galvanized iron sections hinged so as to collapse inward. This is placed on the ground and as the sand is excavated it quickly sinks into the hole. It is then collapsed, an iron cylinder dropped inside, the cone is withdrawn and the pole placed in the cylinder, sand being shoveled into the surrounding space to hold the pole in position.

The purpose of the cylinder is to protect the pole from the effects of the drifting dunes characteristic of this country.

PROPER BUSINESS METHODS

BY C. F. BUTTE.

(The question of cost keeping is one of vital importance to the contractor and dealer. Here is a timely paper recently presented before a meeting of the Electrical Jobbers, Contractors and Dealers' Association of San Francisco wherein the author, who is a prominent electrical jobber of that city, forcefully presents the fundamentals to be observed by the contractor and dealer in the business management of their organization.—The Editor.)

Two hundred thousand firms out of two hundred and sixty thousand firms engaged in business in the United States are merely eking out an existence. One hundred thousand of them have not earned a penny is the report of the Federal Trades Commission after surveying the field for a period of one year.

Out of 60,000 successful firms doing a business of approximately $100,000 a year, 30,000 of them charged off no depreciation whatsoever. Only 10 per cent of the 260,000 firms know the actual cost of handling and selling their products. Forty per cent of them merely estimate their cost and 50 per cent have absolutely no idea of their cost, but merely haphazardly guess and establish their costs arbitrarily Invariably this 50 per cent of the firms establish their cost and prices on the basis of the selling price of his competitor and with this knowledge as a basis they invariably cut prices, demoralize the business in which they are engaged and create a further ruinous condition as their competitors again use the information and selling price established as a basis for establishing new prices and costs. In other words Firm A will use the prices of Firm B to establish his prices, whereupon Firm C will use Firm B's prices to establish his price and so on down the line.

Is it any wonder to you, gentlemen present, that a demoralizing condition exists in many business lines when the Federal Trades Commission finds these existing conditions in their inevstigations?

May we hope that some day all business firms will be gradually extended the helpful machinery of the government as is now done by the Interstate Commerce Commission to the railroads and shipper, by the Railroad Commission of California to the public service corporations, by the Department of Agriculture to the Fruit Growers, Farmers and Dairy Producers' Association and by our recent market commission to the farmers and producers of California.

However, while we are awaiting the day of governmental support and control, what are we to do to helpfully aid and correct the immediate situation?

Well may we say that associations such as our association, the California State Association of Electrical Contractors and Dealers and many similar organizations realize that education and education of its members are the only available means wherewith to correct the present existing evils.

Not by forming any combination to fix prices, not by any pools to gamble on contracts, not by any cliques to add arbitrary additions to bids or proposals, but by the slow, difficult and tedious method and process of educating the members how to do business, how to keep proper records of costs, how to properly estimate values and quantities do we hope to drag ourselves out of the 50 per cent class and out of the 100,000 previously referred to and mentioned in the Federal Trades Commission Report.

However, while the membership of the particular craft organizations are gaining knowledge concerning their business affairs, we have still to contend with the non-members within the 50 per cent class and the 100,000 and who follow the process of A and B and C previously mentioned, many of whom cannot, will not and do not gain any knowledge or training without the hard knocks of failure and bankruptcy, of which there were 22,000 last year, unless the governmental aid comes forward and carries into effect and force some of the recommendations of the Federal Trades Commission—one of which is—That all firms must be members of their respective craft organizations.

In a very recent report issued by the Federal Trades Commission, the following portion under a heavy type caption appears—Many Businesses not Profitable.

> **A large proportion of businesses are not making the money they should. A great number of them are actually losing money. The purpose of conducting a business is to make money, and the only way to make money is to sell something for more than it costs. The first essential, then, is to know the cost. It is the belief of the commission that the small margin of profit existing in so many of our industries is due to the ignorance on the part of the firms of what their goods actually cost to produce. This ignorance causes them to make unprofitable prices, which the firm who does know his cost is forced to meet to a large extent.**

It is a fact too little realized that an accurate determination of cost is fundamentally related to efficiency and proper business methods.

The ranks of those who fully realize the necessity of a proper cost is filling up day by day and every recruit joining the ranks can feel that he is doing his part of the work towards the improvement of business conditions generally and particularly his own.

Again quoting from the report previously mentioned:

> **Cost is defined as the amount or equivalent paid, or charged or given for anything; loss of any kind, expenditure, outlay, as of money, time, labor.**
>
> **This equivalent may be in the form of money paid for material or for labor, or for some one of the many kinds of expense or loss that exist in every business. It is apparent that cost consists of three elements, viz, material, labor and expense.**
>
> **The problem is to ascertain the amount of each of these elements, and in order to accomplish this in the simplest and most practical manner the firm has recourse to system. System is defined as a regular method or order, a formal arrangement, or a mode of operation governed by general laws or rules.**

In the past many firms disliked to give out information concerning their business. Today the reverse is the case. Trade associations are compiling statistics as to production, shipments and costs for the benefit of their members, and the manufacturer instead of trying to keep this information to himself welcomes the opportunity to supply the data, knowing that his competitors are doing the same thing and that these statistics will be of benefit to himself and to his industry.

The commission is urging manufacturers to determine their costs accurately in the interest of better trade conditions. It believes that anything that is of benefit to an industry is of benefit to the public, and it is also of the opinion that the nearer cost systems approach uniformity the more valuable will be the results.

During the past ten years the best accounting brains in the country have been devoting a great deal of time to the perfection of general laws or rules which will give the desired results with the least effort and expense, and the outcome of their work is what is known as a "cost system." This provides not only for the determination of the amount of each element of cost properly chargeable to each job or operation, but also provides for an improved method of bookkeeping which causes the books to reflect at all times the true financial and industrial condition of the business and renders possible the preparation of monthly statements of conditions, as well as complete monthly statements of financial operations.

Cost system or means whereby we determine the cost of our work is the vital part of our entire existence. Without a proper cost, a proper proposal cannot be made and without a proper proposal a proper return for our work cannot be had:

The first element of cost is material. Material is of two kinds, direct and indirect. Direct material is that which forms part of some particular job and can be so charged. Indirect material is that which can not be located as belonging to a particular job, and which is more in the nature of general supplies. This class of material is sometimes termed "expense material," as its ultimate destination is the expense account of some department.

The second element of cost is labor, and this, like material, is divided into two classes—direct, or, as it is sometimes called productive labor, and indirect, or non-productive labor. Direct labor is that which is applied directly to the job and which can be so charged. Indirect labor is that which can not be located as belonging to any particular job, but must be charged to the expenses of some department.

The two elements of cost are fixed in all cases by the specifications and plans and can be determined by proper estimating methods whereby quantities of materals and kinds are computed and the labor itself estimated accordingly.

We now come to the third element of cost generally termed Overhead Expense or sometimes "Burden," too often in the past a "burden" on the contractor's illusive imaginary profit:

Overhead expenses is the expense of every kind connected with the business, none of which can be directly located as belonging to a particular job. These expenses, while part of the cost of a job, are general; hence a method must be devised for them to reach the cost sheet in an indirect manner, the method at the same time being so planned that each job will receive its fair proportion of the total.

To determine the proper proportion each job must bear of the overhead expense, you must again realize the absolute necessity of keeping a proper cost in your business. In order that you may more fully appreciate what may come under this head, I will transgress a few minutes and list some of the items that should be listed and charged thereunder:

In spite of the continued emphasis placed upon the necessity for considering overhead expenses in determining the cost of construction work, the custom still persists among many inexperienced contractors of neglecting this item. It would seem that no man could remain in business very long without realizing the existence of this item of cost and the necessity of including it in his estimates of the expense of contemplated work. Yet evidence frequently comes to hand that contractors are doing this very thing. To succeed in business the contractor must not only realize that overhead expense is an essential element in the cost of doing his business, but he must know how to determine what it amounts to in his own particular case. The contractor who does not keep his cost figures in such shape that he can tell what his overhead expense actually is, is engaged in a gambling operation, and sooner or later fortune is likely to be unkind to him. In the meantime he is a disturbing factor in the business and does an injury not only to himself, but to his fellow contractors.

The items that generally constitute overhead expense and that should be listed thereunder are as follows:

Rent.
Light, power and heat.
Advertising.
Attorney fees.
Freight, express cartage.
Association dues and subscriptions.
Periodicals, newspapers and reports.
Postage.
Printing and stationery.
Stockroom miscellaneous supplies.
Telephone and telegraph.
Automobile maintenance and supplies.
Commissions not chargeable.
Interest and discounts.
Insurance.
Taxes.
Defective work and repairs.
Tool repairs and losses.
Preliminary expense on jobs not secured.
Superintendence.
Executive expense.
Entertainment expense.
Depreciation of stocks and equipment.
Stock wastage and losses.
Wagon and truck maintenance and repairs.
Office supplies.
Clerical and bookkeeper payrolls.
Stockkeeper's payrolls.
Drivers' payrolls.
Bad debts.

Many of the items that have been mentioned are self-explanatory, however, several should be further elaborated and which I shall dwell upon as briefly as possible.

I will first take up the item of interest that may seem exceedingly insignificant to many, but upon further analysis you will readily agree that this item is a very important one in your overhead expense.

How many present have ever studied the average amount and value of work that is held back on contracts and for which you have invested your capital and the average length of time your capital is thusly not earning anything for yourself? The average contract provides payments of 75 per cent of the value

of work installed in the building, but how often and how long have you materials in your stock room or warehouse that you cannot install owing to the building operations over which you have no control and for which you receive absolutely no payments?

In comparing 35 contracts ranging in sums of $325 to $6500 the average length of time for completion and acceptance is 10¾ months; 10¾ months you have approximately $8500 of capital tied up and at ordinary bank interest of 6 per cent this would amount to $510.

In addition to this item of interest you also have approximately a stock of materials valued at $3000 laying in your stockroom and at 6 per cent on this valuation the interest would be $180.

You can readily see from the previous figures that this one item amounts to approximately 1¾ per cent overhead on a gross annual business of $45,000. This ratio will hold true for any volume of business that may be performed. I have not mentioned any interest on borrowed capital or notes with your banks as I presumed that very few of us have any of these two items.

Depreciation is another item that many fail to place proper consideration thereto and again quoting the Federal Trades Commission depreciation is one of the most important of all overhead expenses:

> **One method of handling depreciation, which is unqualifiedly condemned although extensively used, is to wait until the end of the year and then if the profit and loss statement shows that a good profit has been earned to charge a part of this profit to depreciation. If, on the other hand, the profit and loss statement shows little or no profit, nothing is charged to depreciation. It is difficult to understand how any practical man can take the view that his stock and equipment have not worn out because he has not made a profit, and at the same time have worn out when he has made a profit.**

How many contractors do consider the item of depreciation? If not—why not? Do you believe any business house or jobber that is showing actual profits omits this item?

Another item invariably, perpetually and negligently overlooked is the item of superintendence and executive expense. How many contractors ever give this item any consideration? Do you believe that a contractor should give his time for nothing when personally handling work? Do you believe that a bank gives you the time of the president or cashier for nothing when they charge you 6 per cent interest on money borrowed and no per cent for handling your account? Emphatically no!

Do you believe that the manufacturer gives you the time of himself in making his prices for materials he sells to you through the jobber and which you pay for? Emphatically no! Again no, as all obtainable reports and information shows that the personal drawings and salaries of these officials are charged to overhead under superintendence and executive expense. Then why in the name of God's green country does the contractor give his time away without charging it up to overhead expense and adding it to his cost of doing business?

Are you all so willing to give time away without return? Are you all so willing to come under the head of the 200,000 and merely eke out an existence? Then why continue and do what was very adaptly expressed in one of our earlier papers in these words, "Why does an electrical contractor invest $1000 or $20,000 in supplies and equipment and then work himself down to white hair and a five cent cigar just for the glory of paying rent and being called a contractor?

Tabulated reports show that the average cost of doing business under the classification of electrical contractor is 32 per cent of a gross business of $20,000 annually. For a gross annual business of $60,000 the average overhead expense is 17½ per cent. The overhead expense for a concern doing $45,000 annual business the percentage runs average 26 per cent. Bear in mind at all times that your overhead expense is based on your gross annual business and never on your net cost of material and labor.

Think it over carefully and do you wonder why the electrical contractor has not shown any real profit in his business when these percentages stare us in the face? These averages are not only based on reports from our state association, but on our national organization reports as well.

I will now come to the most abused, most unconsidered, and most important fact connected with our business and that is profit.

Have you heard of firms doing a good business, flourishing in all departments and making money with their reports showing a 12½ per cent net profit? Yes, such firms exist and in order to make a 12½ per cent net profit with an overhead expense of 25 per cent such firms add 60 per cent to the cost of material and labor or the actual cost of their product. With a 20 per cent overhead it is necessary to add 50 per cent to the cost of labor and material in order to make a net profit of 13 1/3 per cent. Yes, only 13 1/3 per cent net profit when you add 50 per cent to cost with overhead at 20 per cent.

The average electrical contractor has an overhead expense of 22 per cent. Adding 25 and 20 to your cost only nets you 11 1/3 per cent net profit. Is there any architect, owner or engineer that would disagree with the statement that a contractor should at least earn 11 1/3 per cent net profit for his capital invested, for his engineering knowledge, for his labor handling problems, for his merchandising ability, for his salesmanship and executive ability, for his responsibility and for his business qualifications?

Again reverting to the 200,000 and in conclusion:

> **Of bookkeeping I knew nary a line,**
> **Of credits and finance the same;**
> **But still, I went into the business**
> **Of wiring— a wonderfully easy game.**
>
> **I never considered such trifles as rent,**
> **And taxes and insurance, thought I,**
> **Were small considerations after they were spent.**
> **My profits would show bye and bye.**
>
> **What knew I of overhead expense,**
> **Or the items of which it was made?**
> **They told me it was at least 34 and six-tenths,**
> **The monthly amounts which I paid.**
>
> **There were thirty-nine reasons all together**
> **Why I failed and was put on the "run,"**
> **The thirty-ninth and most important was—**
> **I should never have begun.**

Toppled Tower of Southern Sierras Power Co.

Wires Down Along Pole Line of Nevada-California Power Co.

A Cross Arm That Failed.

(The great power lines of the West are constantly exposed to severe atmospheric conditions. Here are some views, just taken, showing in a striking manner how sleet and snow have recently damaged transmission systems in the high Sierras.—The Editor.)

NEVADA TRANSMISSION LINES DAMAGED BY STORM.

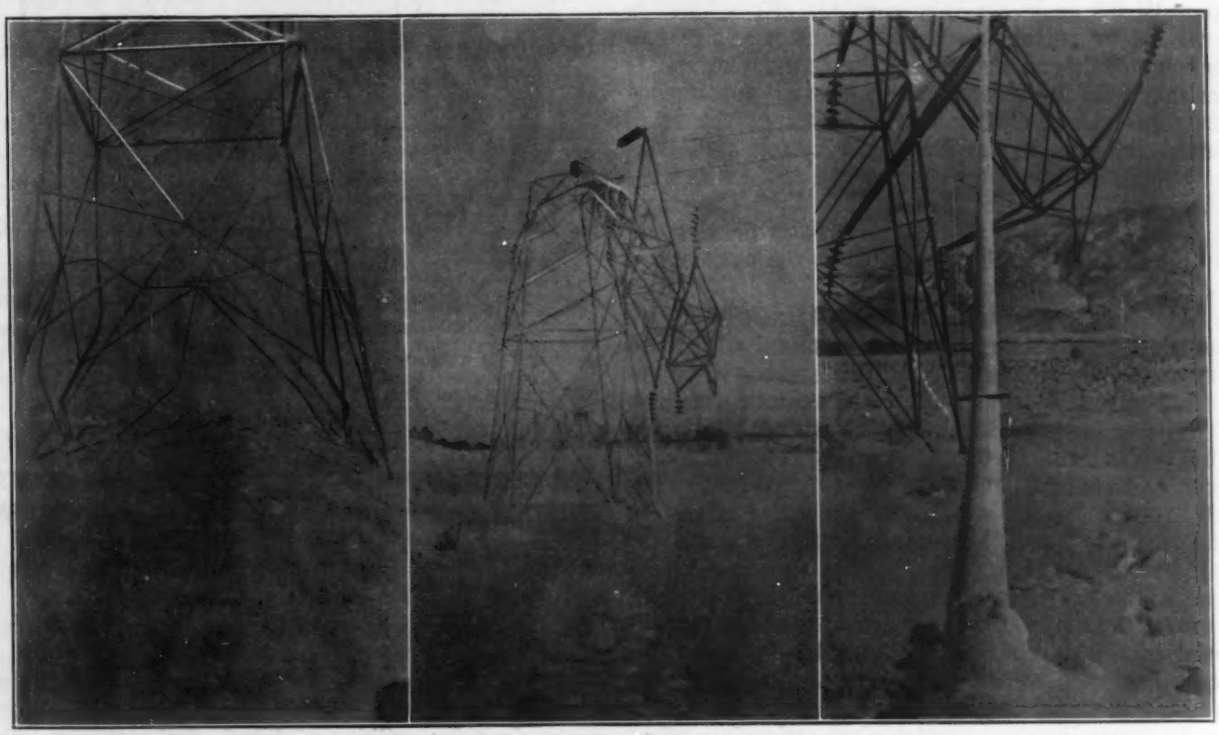
The disastrous effects of sleet on high tension transmission lines is graphically portrayed by the accompanying pictures of portions of the lines of the Nevada-California Power Company and the Southern Sierras Power Company. These lines lead from hydro-electric plants close under the eastern scarp of the Sierra Nevada Mountains to supply power to the mines of Goldfield, Nevada, and the orange groves of Southern California.

Late in December, 1916, they were subjected to unprecedented storms of snow and sleet. The sleet froze as it touched the wires, soon forming a cylinder of ice weighing three pounds or more per foot of wire, some of the wires being six inches in diameter. The dead weight of the ice-covered wires together with the strain of a fifty mile wind caused a number of towers to fail, thus interrupting the power service.

The towers carried two circuits with 660 ft. span, these with the ground wire giving a load of at least six tons.

The towers were designed with a factor of safety of 2 to withstand the weight of a one-half inch coating of ice and a wind velocity of 75 miles an hour. To anticipate constructionally the unusual strain to which these towers were subjected would not have been financially possible. It is cheaper in the end to repair such damage as it occurs.

It is of interest to note that no two towers failed in the same place. One was buckled by the weight, the cross-arm of another gave way, a third failed at the mast, while yet another was completely toppled over.



A Crumpled Tower Base

Broken at the Mast

Ice Clad Guy Wire Compared With Foot Rule

SHORT JOURNEYS IN PACIFIC LANDS

(The trend of recent engineering and commercial development looking toward closer relations with our foreign neighbors has leaned toward the formation of home corporations with sufficient financial backing to properly enter the foreign field. Below is an interesting announcement which shows by special instance this recent phase of evolution in our national life.—The Editor.)

CLOSER ENGINEERING AND COMMERCIAL RELATIONS WITH ARGENTINE.

Indicative of the increasing commercial and engineering relations with South America may be cited the recent meeting of leading manufacturers of the United States at the Manhattan Hotel in New York City. This meeting was held to perfect the organization of the Argentine Mercantile Corporation which marks the success of efforts by the American manufacturers for the past six months to form a coalition for the purpose of marketing their goods in the rich Argentine country, under the first workable co-operative plan ever attempted for exporting goods from this country.

Coincident with the announcement of the plans of the Argentine Mercantile Corporation made, it became known that the organization has been incorporated in Virginia, with a capital of $5,000,000, and that when the co-operative enterprise is fully under way it is expected that the bulk of this capital will be employed in marketing their goods.

The feature of the organization is that no competing lines of goods will be carried and that each manufacturer will bear a share of the expense of marketing his product in Argentine in proportion to the extent of his business. The corporation combines in one solid organization, the distributing, selling and financing of the merchandise of the manufacturers. It has taken for its salesrooms in the city of Buenos Aires an entire building in the center of the retail district, adjacent to the Plaza de Mayo, in Calle Defensa No. 140 to 148. Purchasing and forwarding offices are to be maintained in New York City until an adequate building in the water front district can be obtained to be entirely devoted to the purposes of the corporation.

Until then the manufacturers will use 3700 square feet of floor space in the Bush Terminal which has been taken under lease, and which space will be increased as rapidly as additional room can be obtained.

The building in Buenos Aires which is now being fitted up for the corporation, and will probably be occupied by next March, is being outfitted in a splendid manner for the display of the samples of the allied manufacturers. Each classification of trade will be exhibited in a separate department and each department will be in charge of an experienced manager, with a competent corps of salesmen and travelers experienced in the merchandise trade and customs of the Argentine.

In explaining why the allied manufacturers have chosen Argentine as a sole field for putting into effect their advanced views as to the proper method for obtaining South American trade, it was pointed out at the meeting, that the importance of the Argentine as a customer, and the assured commercial future of the country, will make it necessary for them to limit their scope to this country alone, and to concentrate their energies at Buenos Aires.

The importance of the Argentine as a customer for American made goods of every kind is shown by the fact that the imports to that country in 1913 were $421,352,542, and in 1914 were $271,817,900, a decrease of 35½ per cent. The imports in 1915 dropped to $226,892,733, a decrease of 46 1/6 per cent from 1913. During that three-year period the exports were $1,391,039,331, against imports of $920,063,175, leaving a balance of trade in favor of Argentine of $470,976,156, which is now awaiting expenditure. This amount is a per capita increase of $59 in the wealth of the country in three years. Of course this trade balance is largely due to the fact that the Argentine has been unable to buy in the European markets where it has been accustomed to trade, and the American market is an untried experiment to them.

EVIDENCE OF FOREIGN INTEREST IN ELECTRICAL AFFAIRS.

The following letter will undoubtedly prove of intense interest to readers of the Journal as an indication of the awakening attitude in foreign lands toward matter sent out through our columns. The letter is from Calcutta, India, and enclosed a clipping from one of our display advertisements:

6 Mangoe Lane, Calcutta,
November 17, 1916.

Messrs. The Pacific States Electric Co.,
San Francisco, U. S. A.

Dear Sirs:

I was much interested to see the enclosed advertisement in the Journal of Electricity, Power and Gas.

As far as I am aware, motors for operating talking machines are unknown in India, but I do not see any reason why this useful novelty should not catch on in this country.

It is, however, essential that the machine should be small and handy and not too expensive for it to make headway here, as electricity is only provided in the large towns and in the houses of the rich, so the field is to a certain extent limited.

Will you therefore kindly send me all the literature available on the subject, your special sales proposition, weight, size, price C. I. F. Calcutta and in Indian currency if possible.

Also kindly let me know whether you are prepared to grant sole agency terms for the whole of India.

Yours faithfully,

C. W. HOBSON.

WATER POWER CONSERVATION IN CHINA.

The importance of future waterpower conservation is being agitated in China, although at present China possesses untold natural possibilities for water power development. Popular lectures on the importance of forestry to China have recently been given in Peking under the auspices of the Chinese Forest Service, of which an American, formerly Chief of the Philippine Bureau of Forestry, is co-director. The lectures have been given by a Chinese official of the service, who is a graduate of the Yale Forest School and has published valuable material in Chinese on the subject. They are accompanied by an exhibition of Chinese woods.

DISCUSSION ON ELECTRIC LOGGING.

The discussion on Electric Logging on page 40 of the January 15th issue of the Journal by Mr. F. D. Weber is so manifestly the result of a careless and hurried reading of the paper in question that I consider it only fair to call attention to some of the inconsistencies of some of Mr. Weber's statements.

In the first place it will be noted on page 21 of the Proceedings of the Eighth Annual Session of the Pacific Logging Congress that the figures upon which the costs in the paper are based are applicable strictly to only two camps in the Northwest which were studied in detail. The object of the paper was not to show, as Mr. Weber seems to suppose, that electric logging is the universal solution for all logging troubles, but to show how it figured out in these two cases. Mr. Weber's attempt therefore to make a general discussion out of the paper is not warranted.

Mr. Weber further states that he will "Endeavor to point out wherein many engineers and loggers familiar with logging conditions in the Northwest do not agree with him," referring to the following statements: "The first and most important final answer to the question as to which logging machine is most suited for a particular duty is represented by the dollar mark." Mr. Weber has not even quoted the passage correctly as a reference to page 20 of the Proceedings of the Logging Congress will show. Mr. Weber seems to have some peculiar idea in that line, but it is certain that the engineering success of a project is measured by its ability to earn a return on the money invested, and that is all that the statement which he criticises means.

Mr. Weber further states "It would be necessary to furnish at least 350 kw. of capacity for each logging donkey." In other words, following his line of argument, a generating plant to supply the city of San Francisco would have to be built with a capacity equal to the sum of the instantaneous peak loads of all the customers of San Francisco, regardless of the time at which these peaks occurred. It is a little difficult to see by what line of reasoning Mr. Weber gets his authority for omitting all consideration of diversity factor. A careful study of the paper in question will reveal the fact that the figures are given as plainly stated in the article in dollars per donkey when considering an installation of five machines, thereby taking advantage of the diversity factor of such a load combined with the electric sawmill load. On this basis 35 per cent of the cost of an $80,000 power plant is set aside to be charged against the donkeys. Using Mr. Weber's figure of $65 per kw. this will supply a 1250 kw. plant to drive the electrified sawmill and take care of the five donkeys. At this point it must be emphasized that the figures given were secured by examinations of particular projects and it would be entirely possible, of course, to build a sawmill that would require a greater capacity than this.

Considering the diversified load of the sawmill of which a great many recording watt-meter charts have been taken in a study of this feature of operation and the fact that in the operation of five logging donkeys in the woods it is very seldom that more than two are in operation at the same time, and further that the 350 kw. demand spoken of by Mr. Weber occurs only for a few seconds, the weakness of his statement is at once apparent. The apportionment of the charges in the paper discussed were made after a careful consideration of all these factors and the instantaneous over load capacity of the generator, and while it is not even hoped that the figure arrived at is exact it is certainly much closer to the actual conditions than Mr. Weber's statement implying that the maximum capacity of a plant must be equal to the sum of the maximum demands occurring regardless of when they occur.

I know of no basis for the following statement, "We understand that Mr. Peaslee's figures are for one donkey plant equipment instead of five as stated in his paper." A reference to page 21 of the Logging Congress Proceedings will show that this situation is fully explained as stated above.

Referring to Mr. Weber's transmission lines, his statement that ten miles per donkey is a conservative estimate would mean fifty miles of transmission line to furnish the five donkeys. The figure of 3.2 mile per donkey indicated by the article referred to was arrived at by study of the locations for two years of the donkeys in the two camps under consideration and was ample for these camps. Of course the amount of transmission line required for any given case should be taken in discussing that case and general figures are not applicable.

Mr. Weber's ingenous showing that the power costs based on 1.5 cents per kw.-hr. are not permissible rather loses force when it is learned that the managers of two of our power companies of the Northwest have offered the author power contracts for combined sawmill and logging operation that meet this figure and in one instance where it was possible to operate a synchronous motor for power factor correction the rate offered was considerably less than this. On page 12 of the Proceedings of the Fourth Annual Session of the Logging Congress an offer was made by the assistant general manager of the Olympic Power Company of power at an equivalent rate of 1.5 cents per horsepower hour. It is hard to believe that the men managing and operating these companies are going to take any business that will not at least develop into a profitable load. The power rates quoted by the author were made after a thorough consideration of the load factor characteristics of several electrically driven sawmills and the Potlach Logging Donkeys.

With regard to Mr. Weber's emphasis of the fact that there is no electric logging of fir timber carried on at this date and his contention that therefore the author's statement that the electric donkey will handle 25 per cent more logs in a given time than the steam donkey is purely speculative, reference should be made to the Proceedings of the Fourth Annual Session of the Pacific Logging Congress wherein several men of considerable experience stated this feature emphatically. If the electric donkey, in handling pine, will handle logs 25 per cent faster than the steam donkey, is it so unreasonable to assume that approximately the same ratio of operating speed can be obtained with proper design in handling fir? Mr. Weber's statement that this assumption is purely speculative hardly indicates a careful study of the logging literature available.

Regarding Mr. Weber's criticism of the proposal that cables might be bought on a guaranteed mileage basis, the following statement may be of interest. One large logging concern on the Pacific Coast is at present purchasing their logging cable on a guaranteed mileage basis and representatives of certain foreign firms are at the present time quietly informing certain purchasers of logging cable that after the war they will be prepared to take orders for cable for logging purposes on this basis. Mr. Weber seems to forget that automobile tires purchased on a guaranteed mileage basis run over sandy and rocky grounds and skid around short bends, yet no one questions the purchase of automobile tires on this basis.

Regarding Mr. Weber's fears as to the danger from electric shock it is very encouraging to note that some engineers of unquestionable ability are of the opinion that the danger voiced is entirely negligible under proped operating conditions. Dynamite is very dangerous when improperly handled, yet we do not hear many advocates of the discontinuing of the use of dynamite for blasing purposes.

The whole question may be briefly summed in the statement that every proposed electric logging installation is an individual problem and must be treated as such and that the basis for decision for or against the electric donkey must be the return it can earn on the money invested.

W. D. PEASLEE.

ALKALI ACTION ON POLE LINE CONSTRUCTION.

A remarkable example of alkali action is shown in a recent issue of the Reclamation Record.

The photograph here reproduced was taken on the Uncompahgre Valley project. The "brooming" of the telephone pole just above the ground surface illustrates in a rather unique manner the expansive action of alkali salts. The project manager states that the water surface at this location is at or very near the ground level throughout the entire irrigation season, and a heavy coating of alkali is visible in the photograph. The pole is of western cedar, and has been in

The Brooming of a Pole Due to Alkali

use about 15 years, according to the statement of the Colorado Telephone Co.

It is interesting to note that all the fence posts shown are similarly affected, except the third from the foreground. This post is a peeled cottonwood, while all the others are native cedar. An examination by our engineers of the fence posts in the vicinity brought out the fact that cedar is more susceptible to alkali action than either pinion or cottonwood. The explanation is undoubtedly to be found in the relative porosity of the woods. It is evident that in the treatment of poles or timbers of porous wood exposed alternately to saturation and crystallization of alkali salts a waterproof coating is necessary. Impregnation to prevent decay would be effective only to the extent to which the pores remained permanently filled with preservative.

RECENT STEPS TO OVERCOME ELECTROLYSIS.

The electrolysis survey of the city of Omaha, Neb., by the United States Bureau of Standards was completed a few weeks ago and a report is being prepared to show the measures that must be taken to remove the difficulty. The bureau acknowledges valuable co-operation on the part of the various utilities involved in this work, which promises to have especially important results.

The engineers of the Bureau of Standards are also examining the installation at Springfield, Mass., to see how nearly the results agree with predictions made from the design of their system. If everything is satisfactory, the same system will be installed throughout a large part of the city of Springfield.

OIL FUEL A NECESSITY.

According to the Secretary of the Navy oil fuel is a necessity for the efficient operation of the modern man-of-war. All serious minded citizens should give the matter serious consideration. Editorial comment is made elsewhere in this issue upon this matter. The following are some of the points urged by the Secretary of the Navy to back up his assertions:

When the three-year program already authorized by Congress is completed the navy will require 6,721,000 barrels of fuel oil annually during peace and about three times that amount in the event of war. All new ships are oil burners, and the securing of an adequate supply of oil for the future is a matter of prime importance to the navy. The superiority of oil-burning ships is so great that the Navy Department desired to build oil-burning battleships, but felt that a deterrent, affecting use of oil fuel, was the fear of a failure of the supply.

In 1913 the cost of fuel oil was so great and the number of bidders on the navy's oil requirements so few that in March of that year, before definitely entering upon the policy of constructing only oil burners, the Navy Department wrote to the Department of the Interior asking for information regarding the probable fuel-oil situation twenty years hence and the probbility of being able to secure an adequate supply for the prospective oil-burning fleet. The Department of the Interior replied: "Relief to the navy from increasing commercial prices can probably be secured only by development of its own reserves. * * * It is believed that the Department of the Navy may rely upon the reserves already existing for a supply of fuel-oil for a period greater than the life of any battleship to be constructed within the next decade."

RECORD BREAKER FOR PETROLEUM.

That 1916 was a record-breaking year for the petroleum industry of the United States is indicated in a preliminary estimate of the output of crude oil made by John D. Northrup, of the United States Geological Survey, Department of the Interior.

Mr. Northrop estimates that during the year just closed 292,300,000 barrels of crude petroleum were produced and marketed in the old fields of this country. This quantity is greater by 11,000,000 barrels, or 4 per cent, than the output in 1915. In addition to the quantity of oil produced and maketed in 1916, several million barrels were produced and placed in temporary field storage in Kansas and Oklahoma.

The following table shows by states the marketed production of petroleum in 1915 and an estimate of the production in 1916, in barrels of 42 gallons each:

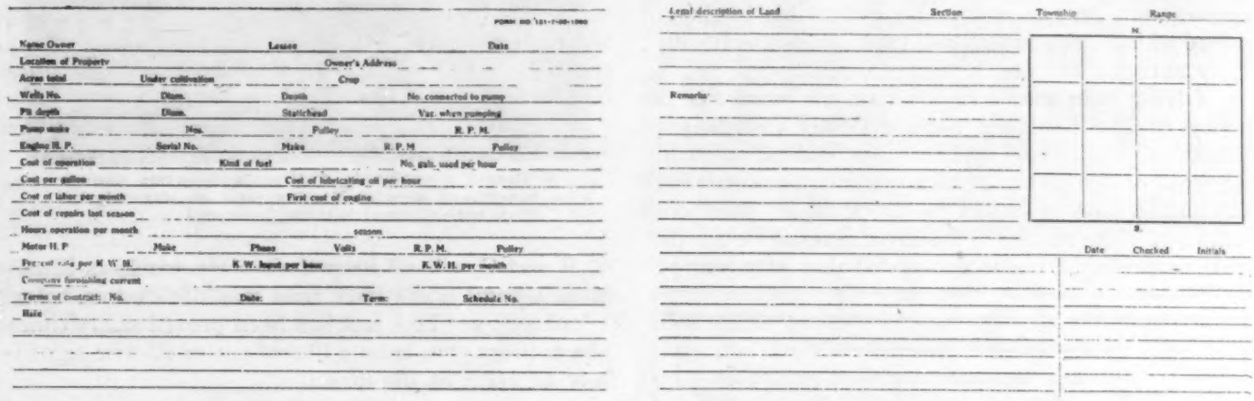
State.	1915.	1916.
Oklahoma	97,915,243	105,000,000
California	86,591,535	89,000,000
Texas	17,467,598	26,000,000
Illinois	19,041,695	16,500,000
Louisiana	18,191,539	15,800,000
West Virginia	9,264,798	8,500,000
Pennsylvania	7,838,705	8,000,000
Ohio	7,825,326	7,400,000
Kansas	2,823,487	6,500,000
Wyoming-Montana	4,245,525	6,300,000
Kentucky	437,274	1,200,000
Indiana	875,758	1,000,000
New York	887,778	900,000
Colorado	208,475	190,000
Other States	14,265	10,000
	281,104,104	292,300,000

MERCHANDISING ELECTRICAL ENERGY

BY ROSS B. MATEER.

(The efficient merchandising of electrical energy is the great problem of Western hydroelectric companies. The constant creating of new uses and new outlets for electric service is welcomed on all sides. Here are some ideas that have been worked out to great advantage at Riverside, Cal., where the author is commercial engineer for the Southern Sierras Power Company.—The Editor.)

Many quasi public utilities report rapidly increasing sales of energy in markets heretofore supplied with service and now yielding as it were a return on the capital expended in efficient sales effort and indexing. Such gain it seems should be abundant proof to the executives of every central station that the systematic expenditure of funds on complete canvasses of present and prospective consumers, on the maintenance of up-to-date card records of appliances and current consuming apparatus in service, and the intelligent following up and closing of possibilities gleaned by an analysis of the indices is more than justified even



Front and Reverse for Index and Data

though frowned upon a few years ago by many apparently intelligent and capable business men.

Large sums were usually provided for development work, the locating of power sites, the construction of large reservoirs, the installation of generating machinery and the building of expensive transmission lines but when funds were requested with which to market the energy harnessed and as it were brought to your door by engineering skill a cry is heard from executive officers, unfamiliar with the sale of current and who frequently hold the view that "juice" like groceries is sought by the prospective customer and that convenience of electric light or power will commend it over all other illuminants or fuels irrespective of the expense for equipment or the cost per kilowatt hour.

Merchandising methods of the dark ages are not in vogue today. Salesmen are not sent out to take orders from shop-keepers merely to have their goods on the shelves but wide-awake, aggressive, intelligent high salaried engineers are placed in the field to dispose of and market the stock of the merchant and to create such a demand for certain commodities that the local distributor must file ever repeating and increasing orders with the manufacturer. So electricity must be marketed by creating a demand for such current consuming apparatus as will increase the efficiency of the pumping plant and save a few steps in the home.

Canvas cards may vary in detail to the purpose for which they are desired but the general characteristics remain the same and when used in conjunction with a chart indicating the geographical location of the plant, distribution systems now installed, the acreage susceptible to and at present under cultivation, become of inestimable value not only to the aggressive sales agent but to the progressive commercial manager, by portraying the territory served and the growth in connected load.

At Riverside, California, The Southern Sierras Power Company has built along one wall of the general agent's office a large map consisting of thirty removable panels, each 15½ by 15½ inches and representing a certain township and range, over which the transmission line and the distribution system of that utility has been built. On each panel is traced the principal property lines as recorded in the assessor's office, the natural water courses, gravity ditches and some county roads. On each tract of land is indicated (1) the name of the owner of record, (2) wells drilled but without equipment, (3) wells pumped with fuel or oil engines, (4) wells pumped with electric service, (5) the out door substation, transforming the voltage from 33,000 to 2200 or 440, (6) prospective business requiring immediate attention, and (7) industrial power installations. By the use of color headed tacks one can almost at a glance note the ratio of possible or probable business to that actually connected to the lines.

The legend follows:

Well location		White headed Tack	
Drilled Well		Bisected White Tack	
Engine Equipment		Black headed Tack	
Comp. Elec. Equip.		Pink " Tack	
Contracted		Grey & Black " Tack	
Active prospect		Red headed Tack	

A further examination of the consumers record card will show references to the acres owned by the portion actually irrigated by the pumping plant. By adopting a legend, yellow for fertile soil and green for cultivated acreage the chart becomes more attractive and at all times tells the story not only of a utilities aggressiveness, but of man's conflict with nature and his victory.

Data as to acreage permits of further analysis and the determination of such interesting data as the cost per season per acre irrigated, the acres cultivated per horsepower connected and, the cost per horsepower per season. Unit costs may arm the salesman and assure a contract as much as a timely glimpse of an efficient index permits of a campaign on seasonal appliances. Do you maintain a get-at-able intelligent record of your consumers and their wants electrically? Why not?

Giving your customer his money's worth, is the policy of The Southern Sierras Power Company of Riverside, California, and to this end all monthly accounts of residential consumers have been carefully scrutinized with reference to the kilowatt hour consumption. The results of the investigation were somewhat surprising when it was noted that fifty-four per

Additional Service Without Expense

We note that during last month you did not use all of the energy to which you were entitled under your minimum charge. You might have used more lights, larger lamps, an iron or other convenient appliance, without additional expense.

We like out customers to receive a full measure of service for a given sum and hope you will plan to utilize an additional quantity this month, let us help you improve your service.

THE SOUTHERN SIERRAS POWER COMPANY.

cent of its patrons used each month only two-thirds of the kilowatt hours due them under the regular minimum charge.

Accordingly the next regular statement carried a small "teaser" reading somewhat like this:

Results were apparant immediately. Residences were illuminated to a later hour. Some current consuming appliances were marketed, and less than fifteen per cent of the consumer's meters recorded a consumption below the minimum when next read. This percentage is slowly decreasing while the number of satisfied customers is rapidly increasing. A little judicious advertising pays a good interest on the investment.

The manufacture of nitrogen products from the air heralded as a possible utilization of Western water powers, will need an abundance of natural lime deposits. The Pacific Coast States, including Idaho, produced 95,000 short tons of lime in 1916, or 3 per cent more than in 1915.

THE ELECTRIC SIGN AS A LOAD BUILDER.

BY T. W. SIMPSON.

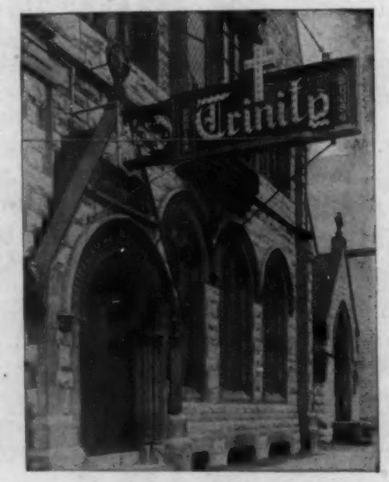
One hundred kilowatts of electric sign load is normal for each 50,000 population in cities and towns, but is far exceeded by some Western power companies who take pains to cultivate this load.

One hundred kilowatts does not indicate very much when compared with similar figures of motor load, but interpreted into income at lighting rates and steady four hour nightly burning it means $8750 per year or 17½ cents per year per capita of population without a dollar of secondary line or meter investment.

Surely, this is a load worth having. But this direct gain is not all. The indirect advantage comes about in this fashion. A puts in an electric sign. His neighbors B and C may not have electric signs, but

A Recent Creation in California showing Across-the-Street Booster Display Sold on Subscription Plan with Central Station Co-operation

A, B and C will all keep their store windows illuminated several hours later than was the custom before A had a sign. This fact has been proved many times. The indirect gain from a liberal use of electric signs is fully as great as the direct.



A Dignified Sign for Church Display

Years ago the electric sign was looked upon as a splendid load builder. Of late years, owing to the interest attending the introduction of other energy consuming devices, its inherent value has been overlooked. It is as good today as it ever was. And it is just as true now as ever that it will not grow by itself and that it requires co-operation on definite lines between power company and sign manufacturer before it can be obtained.

ELECTRIC POWER FOR IRRIGATION PUMPING

(The efficiency of electrically operated pumping plants is a factor of great importance in recent development of this phase in central station load. Here are data collected by a technical specialist of the Pacific Gas & Electric Company that should prove of unusual value to all Western power companies as definite information from tests is set forth covering many fine points not hitherto positively established.—The Editor.)

TESTS OF IRRIGATION PUMPING PLANTS.

BY F. C. PIATT.

In connection with investigations of the character of the irrigation pumping load of the Pacific Gas & Electric Company in the San Jose and Solano districts made in 1914, efficiency tests were made on about 350 small pumping plants. About 90 per cent of these plants consisted of small centrifugal pumps either direct or belt connected to electric motors.

The purpose of this work was to secure data on the general results being obtained. The testing was not done with as much care in individual cases as

P2366. 7-16-17M

PACIFIC GAS AND ELECTRIC CO.
TEST ON ELECTRIC PUMPING PLANT

DISTRICT ..... DATE ..... 19 ..... No. .....

PLANT: OWNER ..... LOCATION .....

CIRCUIT: K. V. ..... No. OR NAME .....

TRANSFORMERS: Co. No. ..... K. W. ..... NOTE OTHER LOADS .....

Co. No. ..... K. W. .....

Co. No. ..... K. W. .....

MOTOR: MAKE ..... H. P. ..... VOLTS ..... AMPS. ..... PH. ..... TYPE ..... R. P. M. .....

PUMP: MAKE ..... TYPE ..... SUCTION ..... DISCH. ..... R. P. M. .....

TRANSMISSION: DIRECT—GEARED—BELTED. SPEED RATIO .....

WATTHOUR METER: MAKE ..... TYPE ..... AMPS. ..... VOLTS ..... PH. .....

C. T RATIO ..... P. T. RATIO ..... TOT DIAL CONST. .....

TOTAL TESTING CONSTANT (W. H. PER DISC. REV.)—K .....

REMARKS: .....

TEST BY .....

TEST-MOTOR INPUT

No.	INDICATING METER		K V A	WATT HOUR METER		K W	POWER FACTOR	% RATED CAP'Y		MOTOR R. P. M.
	AMPS.	VOLTS		REV.	SEC.			TRANS.	MOTOR	

TEST-PUMP

NO.	HEAD FEET			SUCTION PIPE		DISCH. PIPE		GAL. PER MIN.		
	SUCTION	DISCHARGE	TOTAL	FEET	SIZE	FEET	SIZE			

WATER LEVEL BELOW GROUND: NOT RUNNING ..... FT. RUNNING ..... FT.

KNOWN FLUCTUATIONS IN WATER LEVEL .....

TOTAL AREA IRRIGATED ..... ACRES. CROP ..... ACRES .....

NATURE OF SOIL ..... CROP ..... ACRES .....

Front and Reverse of Form for Test Data.

would have been used if recommendations regarding the plants were to have been made to the owners. Care was taken, however, not to introduce any systematic errors so that the mean results secured should be relatively accurate. The form used for recording the data is shown in the illustration. Statistics regarding the use of the water were collected for application in load diversity and other studies.

Volts and amperes were read by portable instruments. The kilowatt load at each plant was obtained by counting the revolutions of the regular watt-hour meter disc, no special test meter being carried. As the meters were in good condition, it is considered that the kilowatts input was obtained quite closely. Revolution counters were used to obtain the speed of pumps and motors.

Measurements of the water discharged were made in various ways. In some cases weirs or tanks were already in place and could be used. Where the discharge was into open ditches, the surface velocity was obtained by floats in straight ditch sections and the discharge obtained by using a coefficient to reduce the surface velocity to the mean. In many cases, where the water was discharged into the air from the horizontal pipes, measurements of the path of the jet were used to compute the quantity. Comparison of these latter methods with more exact methods, where they could be used, indicated that the results were usually within about 10 per cent of the correct.

Measurements of the lift were made directly from the water surface elevations. In some plants it was difficult to secure the exact amount of suction lift as a sounder could not be used between the well casing and the suction. In such cases the suction was estimated.

The efficiency was computed by comparing the theoretical power required to raise the discharge through the actual measured head with the actual measured power delivered to the motor. This expresses the relation between the power which is being paid for and the results accomplished by its use. The efficiency secured is for the plant overall and includes losses in the motor, in the transmission to the pump, in the inlet and outlet pipes of the pump and in the pump itself. The actual efficiency of the pumps will be higher than these overall efficiencies, the amount of the difference depending on the character of the transmission of power from the motor to the pump.

The general results are given in Table I. In the San Jose district the vertical centrifugal pump belt connected to the motor is the prevailing type. In the Solano district the depth to ground water is less and direct connected pumps are more usual. A few deep well turbines and plunger pumps are also used. The results are segregated by types and sizes for the centrifugal pumps. The number of tests on which each mean is based is also given. The efficiencies do not vary consistently with the size in all cases. This is due in part at least, to the wide differences found in individual plants and the smaller number of tests forming some of the means.

In Table I, the mean of the one-fifth of the plants in each classification which gave the lowest overall efficiencies is given for the sizes for which sufficient tests are available. These minimum results indicate the low efficiencies which are being obtained in some cases, due to different unfavorable conditions. Such

conditions are more probably those of poor judgment in the selection or poor care in operation, rather than any inherent fault mechanically of the equipment itself. In the same way the mean of the maximum 20 per cent of the results is given. These show the results which may be obtained with properly selected and maintained plants.

A comparison of the efficiencies for direct and for belt connected pumps, as given in Table I shows no consistent difference. For similar conditions the direct connected pump should give somewhat higher efficiency due to the saving of the belt loss. Where the water level and height of lift fluctuates, direct connection which does not permit variations in speed, may be less efficient as the efficiency of the pump at the given speed varies with the lift. The average lift for the vertical belted pumps is higher than that for the direct connected plants so that they can not be directly compared. The lifts for the direct connected and for the horizontal belt connected pumps are similar although the number of tests of the latter type is relatively small. Taking the difference in mean efficiency for the various sizes weighed by the number of tests, gives an average efficiency of about 5 per cent higher for the direct connected pumps than for the horizontal belt connected pumps.

If the belt connected vertical pumps having lifts similar to those of the direct connected ones are similarly weighted, the average efficiency of the direct connected plants is about 3.5 per cent higher.

The average speed of the direct connected pumps is much higher than for belt connection for the same size and lift. This is necessary as the motors have relatively high speeds. When the pumps are designed for such speeds, good results are obtained as long as the conditions do not vary materially. With belt connections the pulleys can be changed to give speeds suited to the variations in lift that may occur during any season or from year to year. The lack of adjustment of the speed to the lift with direct connected pumps may cause a greater loss of efficiency than the loss in belt connection. The rated efficiency of motors varies with the size. Belt losses should not exceed 6 per cent; for worn or loose belts this loss may be exceeded.

The following figures give the usual efficiencies of motors and for motors and belts, the belt loss being taken as 6 per cent of the power delivered by the motor.

Size Motor horsepower.	Efficiency of Motor.	Efficiency of Motor and Belt.
Less 15	86	81
15- 50	88	83
50- 75	89	84
75-100	90	84.5
Over 100	91.5	86

These figures are used to estimate the pump efficiencies given in the last column of Table I. For direct connected plants only the motor loss is deducted, giving the efficiency of the pump and and piping. For belt connected plants the combined motor and belt loss is deducted. For horizontal pumps this gives the efficiency of the pump and piping; for vertical pumps the losses in the shafting are charged against the pump. Estimates made for a number of the plants gave an average friction loss in the piping of about 5 per cent of the power input.

The variation of the efficiency with the size is not as marked as usually found. For sizes of 3½ in. or less, the efficiency is consistently lower. For sizes of 4 in. or over, the variations are smaller and less regular. The number of tests on pumps larger than 6 in. is, however, small. In Table 2, all types of centrifugal pumps are grouped. These show an increase up to the 4 in. sizes. From 4 to 8 in. the variations are small and irregular.

The efficiency of a small pumping plant depends upon so many factors that it is difficult to segregate the effect of any single factor. In Table 3, the sizes for which the largest number of tests are available are segregated by the height of lift. The average for all single stage pumps from 3 to 8 in. in size, and also the average including the two or three-stage pumps, are given. The lower efficiency for lifts less than 20 ft. is quite marked. For lifts over 30 to 40 ft., the difference is not as marked, although there is a small but irregular tendency to increase the efficiency at the higher lifts. This is to be expected as the efficiency of the larger motors will be somewhat higher than for the small ones used on the lower lifts, and the mechanical losses in the pump are a greater proportion of the total input where the lift is small. With equal hydraulic efficiencies on all lifts these factors would give lower efficiencies on the low heads.

In these investigations it was found that the low efficiency of some plants might be due to any one of a number of factors. The most important of these were:

(1) Friction losses in suction and delivery pipes.
(2) Discharge of an excessive quantity of sand.
(3) Poor lubrication.
(4) Loose belts.
(5) Losses in long shafts, generally used in the San Jose territory, due to bearing friction and poor alignment.
(6) Leakage of air through loose stuffing boxes.
(7) Running at speeds not suited to the pump.
(8) Underloaded motors.

The average results for all plants may be of interest as indicating the general conditions in a given territory or with a given class of plant. Where the individual plants vary in so many factors average results are little indication of what will be accomplished in any particular case. The overall efficiency of the 357 plants tested was 35.5 per cent. The average lift was 52 ft., and the discharge 600 gallons per minute. This is equal to 1.33 second feet, or 67 in. as used in Southern California. The probable average efficiency of the pumps alone was about 42.5 per cent. The average overall efficiency is equivalent to the use of 2.9 kilowatt hours for each acre foot of water lifted one foot and also to 5.8 miners' inches lifted 100 ft. for each kilowatt of input. The average input per plant was 15 kilowatts.

For the 104 direct connected centrifugal plants tested, the average overall efficiency was 35 per cent, the average lift 33 ft., and the average discharge 630 gallons per minute. These represent quite closely average conditions in the Solano district as this is the prevailing type of plant in that locality. The average input was 11 kilowatts.

For the 140 vertical belt connected plants tested, the average overall efficiency was 37 per cent, the lift

Table 1. Summary of Results of Tests of Irrigation Pumping Plants.

Kind of Pump.	Size of Pump.	Number of Tests.	Mean Discharge—gal. per minute.	Mean Suction Lift, ft.	Mean Total Lift, ft.	Revolutions per min. of Pump.	Mean Kilowatts Input.	Overall Efficiency. Mean of al Tests.	Mean of Lowest 1/5 of Results.	Mean of Highest 1/5 of Results.	Estimated Efficiency of Pump. Mean of all Tests.
Horizontal direct-connected centrifugal pumps.....	2½	2	175	12	31	1750	4.3	24.6	....	....	29
	3	5	170	15	45	1740	5.2	25.7	....	....	30
	3½	2	260	17	25	1470	5.4	38.4	....	....	45
	4	25	410	13	35	1440	7.8	35.5	17.6	57.0	41
	5	16	470	15	34	1200	9.3	31.1	16.7	42.0	36
	6	23	675	13	32	1250	11.6	36.4	13.0	56.2	42
	7	19	880	14	30	1120	13.2	36.4	21.1	55.8	42
	8	12	1125	16	32	1050	18.6	40.0	18.6	64.6	46
Horizonal belt-connected centrifugal pumps.....	2	7	115	14	25	1225	2.3	26.0	....	....	32
	2½	4	172	13	21	1315	3.4	23.0	....	....	28
	3	13	337	9	22	940	5.9	21.6	9.5	36.4	27
	3½	1	310	11	23	1140	...	10.3	....	....	13
	4	8	375	6	26	800	6.7	25.5	....	....	32
	5	5	410	14	35	780	7.3	38.0	....	....	47
	6	5	560	12	27	760	9.7	24.8	....	....	31
	7	7	690	10	30	650	11.8	32.2	....	....	40
	8	1	1040	..	8	707	19.4	8.6	....	....	10
	10	1	1650	24	28	570	30.5	29.8	....	....	36
	12	2	1980	9	13	440	27.0	27.0	....	....	32
Vertical belt-connected centrifugal pumps.....	2½	1	150	23	49	1540	5.1	27.0	....	....	33
	3	12	315	16	53	1250	10.9	28.2	16.2	43.6	35
	3½	2	375	8	38	915	7.6	35.4	....	....	43
	4	41	495	15	62	975	15.1	38.1	17.4	56.8	47
	5	60	730	16	57	870	20.2	39.6	21.5	58.4	48
	6	20	935	16	46	825	23.0	36.2	20.0	49.2	44
	7	4	1015	19	43	840	22.2	37.4	35.0	39.7	45
Vertical belt-connected two-stage centrifugal pumps	1½	1	100	2	27	2000	2.8	18.2	....	....	23
	3	1	300	12	80	1150	11.6	39.0	....	....	48
	4	9	460	17	110	1025	24.3	40.2	21.4	56.8	48
	5	10	650	17	94	1000	34.9	38.5	20.9	53.0	46
	6	1	625	0	103	625	33.0	36.7	....	....	44
Three-stage centrifugal pumps.....	3	1	300	4	119	1020	17.0	39.4	....	....	48
	4	1	450	0	112	1030	30.0	31.6	....	....	38
Well turbines	..	23	750	6	87	930	27.0	40.8	24.7	61.7	49
Plunger pumps	..	12	60	..	133	...	4.1	46.1	27.8	63.2	57

Table 2. Mean Overall Efficiency of all Types of Centrifugal Pumps.

Size of Pump.	Number of Tests.	Mean Discharge, Gallons per min.	Mean Suction Lift feet.	Mean Total Lift feet.	Mean Revolutions per min. of Pump.	Mean Kilowatt Input	Mean Overall Efficiency.
2	7	115	14	25	1225	2.3	26.0
2½	7	170	14	28	1475	3.9	24.0
3	32	300	12	36	1190	5.1	25.8
3½	5	317	12	37	1180	6.0	31.6
4	84	453	14	56	1100	13.2	36.3
5	91	659	16	56	937	19.2	37.9
6	49	770	14	39	1020	16.5	35.6
7	30	854	14	32	970	14.1	35.6
8	13	1117	15	30	1023	18.6	37.5

56 ft., and the discharge 650 gallons per minute. These are smaller average sizes and lifts than for the other types of plants and the resulting efficiencies are consequently lower.

For the vertical belt connected plants tested, the average overall efficiency was 37 per cent, the lift 56 ft., and the discharge 650 gallons per minute. These results are representative of average conditions in the Santa Clara valley, where this kind of plant is the prevailing type.

The mean results for the deep well turbines are given in Table I. The average efficiency of the well turbines is somewhat higher than that for all the centrifugal pumps of either type. However, the average capacity and lift of the well turbines is greater. When compared with two-stage centrifugal pumps having similar lifts, but smaller discharge, the difference in efficiency is less. The number of tests of well turbines is not as large as for the direct connected and vertical belted centrifugal plants. If the well turbines are compared with the 5 in. vertical belted centrifugal pumps having an average lift of 57 ft., a difference in efficiency of about 1 per cent in favor of the well turbines is shown. The 23 tests indicated that higher efficiencies would be obtained at the lifts of over 100 ft. and for discharges over 800 gal. per min. The numbers of tests are not sufficient to warrant giving numerical values for such differences.

The average for the 12 tests of plunger pumps is also given in Table I. These gave the highest average efficiency of any of the types of plants tested. The discharge was smaller than for other types and the lift greater. The multiple stage centrifugal pumps have the most similar conditions of lift. For all sizes the average efficiency of the multiple centrifugal pumps is lower than the mean for the plunger pumps. The efficiency of the different plants varied quite

Table 3. Variation of Overall Efficiency of all Types of Centrifugal Pumps with the Total Lift.

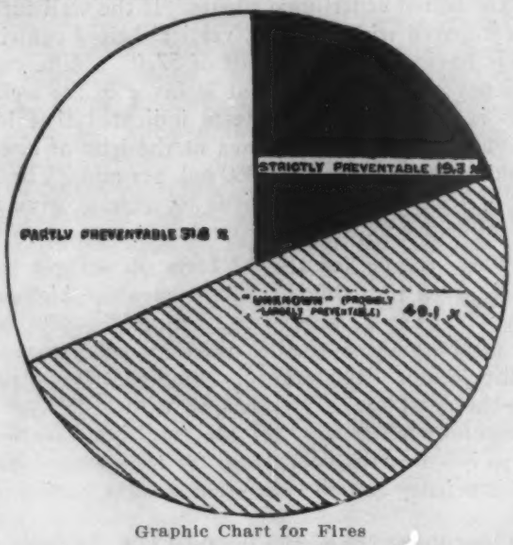
Total Lift in Feet	—4-inch Pumps.— No. of Tests.	Mean Overall Efficiency.	—5-inch Pumps— No. of Tests.	Mean Overall Efficiency.	—6-inch Pumps.— No. of Tests.	Mean Overall Efficiency.	All Sizes of Single Stages. No. of Tests.	Mean Overall Efficiency.	All Sizes, including Multiple Stages. No. of Tests.	Mean Overall Efficiency.
Less than 20.....	3	12.6	3	12.2	5	10.2	24	15.5	24	15.9
20 to 30.....	12	24.8	10	30.4	3	30.9	34	27.8	34	27.8
30 to 40.....	11	36.8	11	35.6	17	40.2	54	38.7	55	38.2
40 to 50.....	14	43.4	11	38.0	10	39.4	50	39.3	50	39.3
50 to 60.....	9	39.4	16	43.5	5	39.1	31	41.7	33	41.0
60 to 80.....	6	46.9	17	41.6	..	....	27	41.8	30	41.2
Over 80.....	11	42.6	8	39.5	..	....	21	41.4	34	42.2

widely, due to such factors as too high piston speed, and excess slip.

It is thought that the number of tests included in the data presented is sufficient so that the figures given are representative of the results actually being obtained in the field use of such plants. The overall efficiencies given are those on which the power costs are based. The wide differences for all types between the average minimum and maximum results indicate that many plants have not been properly selected or maintained. The plants include a number of different makes of pumps. A segregation by makes of pumps showed no consistent differences in the efficiency of different makes. A study of the general results seems to indicate that in many cases the actual efficiency which the pump is capable of obtaining may not be the most important factor in the plant as a whole. If the conditions of use do not correspond to the conditions for which the pump was designed, low efficiency will result, as even a well-built pump can not overcome unfavorable conditions of use. The proper adjustment of speed to lift, proper maintenance of bearings and shaft alignment, and care of the belt are essential to good results. The neglecting of these factors can not be charged directly against the pumps. Where one-fifth of the owners obtain results varying from two to three times better than the poorest one-fifth for the different types of pumps, it is evident that improvement should be possible in at least one-half of the installations.

PERCENTAGE OF PREVENTABLE FIRES IN OREGON.

More than half the fires in Oregon during the year 1915 were either strictly preventable or partly preventable said the National Board of Fire Underwriters, which just completed an exhaustive survey of fires and fire hazards in this state.



Graphic Chart for Fires

To be precise, 19.3 per cent of all the fires are classified as "strictly preventable," and 31.6 "partly preventable," an aggregate of the two classes of 50.9 per cent.

The remaining 49.1 per cent are attributed to "unknown" causes, with the comment "probably largely preventable."

OVER IRRIGATION.

In a recent paper on fundamental principles of modern irrigation practice, Professor Powers of the Oregon Experiment Station calls attention to the possible dangers of over irrigation, in which he says that over irrigation is probably the greatest menace to irrigation agriculture. The danger of over irrigation on sandier soils is that it will leach out the valuable available plant foods, while on the heavy soils, it results in water logging and accumulation of alkali. Water logging causes rotting off of plant roots where they have developed in the deeper soil strata or prevents deep rooting if the roots have not already formed. A shallow rooting plant is not resistant to drought, whereas the main thing to develop in any arid plant is a deep rooting system that is drought resistant. With over irrigation the crop yields are lower for each unit of water used. More plant food is taken up by the plants for each pound of dry matter produced. The quality of the crops is greatly reduced and there is a higher proportion of plants in proportion to fruit or grain produced. Extension of the irrigated area is also hindered and other dry land is cheated of its irrigation water. A permanent system of irrigation agriculture depends on the economical use of irrigation water. If we can save 50 per cent of the water now used, it will mean that we can practically double the irrigable area in the west.

PROPOSED ROADS IN OREGON COMPARED WITH THOSE IN CALIFORNIA AND WASHINGTON.

In the recent commonwealth conference held at Portland, Oregon, John H. Lewis, state engineer thus summarized the roads and total distribution of mileage as follows:

It will require approximately 4200 miles of state roads to connect each county seat and adequately serve all parts of the State.

As feeders to this trunk line system, approximately 8000 miles of high class county roads will be necessary.

We thus have a total of 12,200 miles of state and county roads to be built and maintained in accordance with modern standards required by motor vehicle traffic. In addition there are approximately 33,000 miles of local or district roads which must also be maintained.

With our great area, and limited population and taxable wealth, we are thus confronted with an enormous task. Its magnitude will perhaps be appreciated better by comparison with New York State which has practically the same length of state and county roads. Here state bonds to the extent of $100,000,000 have been issued and expended along with liberal allotments by counties and the system is only about seven-tenths complete.

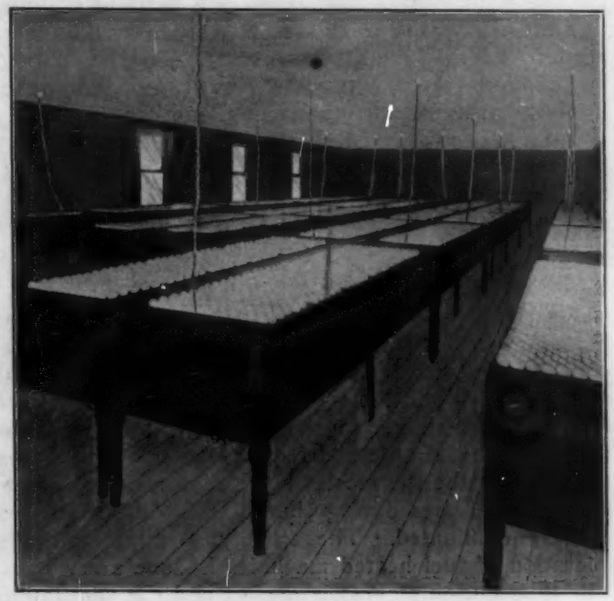
The California state highway system includes 2900 miles or three-fourths that suggested for Oregon. It is estimated that $50,000,000 will be required to complete that system. Washington has 3293 miles designated as state routes.

ELECTRIC COOKING AND HEATING

(The application of electrical energy to the chicken industry in the West has had a most marked beneficial effect. The even temperature that is possible under electrical application is revolutionizing methods in vogue until recently in the great chicken raising districts of the West. Below is set forth an interesting article on this important subject.—The Editor.)

INCUBATING AND BROODING BY ELECTRICITY

Modern Methods.—Although artificial incubating and brooding has been practiced for many years in Europe, Asia, and the United States, the latter country has been most progressive in developing means for utilizing electric heat as a substitute for heat produced by fuel combustion methods. The superiority of electricity is quite obvious to anybody familiar with the poultry business. The number of fuel heated incubators and hovers in use in this country reaches well into the millions, but the vast field which the application of electric heat to these devices has opened up for the manufacturer of heating apparatus and the distributor of electric energy is little appreciated. In one small town in California about 10,000,000 chicks are hatched annually by artificial means. The hatching and brooding of these chicks would require about 3,000,000 kw-hr. per year, if electric operation was substituted for fuel.



Portion of White Hatchery, Petaluma, Cal.
(Capacity 40,000 eggs)

The character of the load is desirable from the standpoint of the central station. The machines are non-inductive, and the diversity factor is naturally high. Where a large number of machines are in use the load is not one that varies greatly with the season of the year as might be supposed.

The processes of incubating and brooding are outlined in order to convey a clearer appreciation of the advantages afforded by the application of electric heat.

Poultry Incubating.—All kinds of eggs may be hatched by artificial means. The period of incubation varies with the kind of egg and with temperature conditions. If the heat has been maintained at too low a temperature during the period of incubation, or if the eggs have been chilled or overheated, the hatching may be delayed somewhat.

The average incubating periods of various kinds of eggs by both natural and artificial methods are as follows:

	Days.
Hen egg	21
Pheasant egg	23
Guinea egg	27
Duck egg	28
Peafowl egg	28
Turkey egg	28
Goose egg	32
Duck egg (Muscovy)	34
Ostrich egg	42

The hatching of chickens by artificial means is perhaps most commonly known, and is therefore described.

Incubating of Chickens.—The eggs are placed on portable trays at an angle of about 45 degrees, with the small ends down, leaving the air cells in the large ends. These trays are then placed in the incubator, and the temperature brought up gradually to 102° F., and maintained at that point for from four to six days, when a test is made. This test consists in holding the tray of eggs to the light. If they are fertile the operator will observe a spider like shadow within the eggs, showing that they are germinating. The eggs that are not fertile will be perfectly clear, and will be removed from the tray. Another similar test is often made about the fourteenth day. After the first test is made, the temperature is usually brought up to 103° F. and maintained at that point until the hatch is off. The temperature is always taken with

Petaluma 200 Egg Incubator

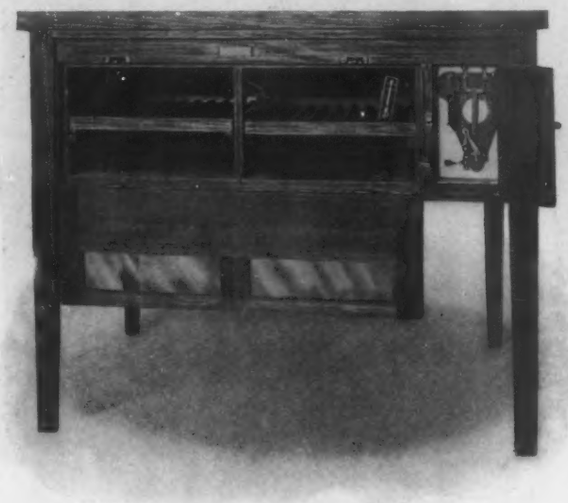
the bulb of the thermometer even with the horizontal plane of the eggs.

After the eggs have been in the machine about seventy-two hours, they are cooled daily by removing the trays from the machine for from one-half hour to two hours, depending upon the temperature of the incubating room. When they have cooled to about the temperature of one's body, (which may be observed by holding one of them against the cheek), they are put back in the machine. The eggs are cooled to allow the germ to rest, for otherwise the chick when hatched would be weak and nervous. Each time the eggs are cooled they are turned at a different angle, but the small end is always kept pointing downward.

Constant observations are made to see that the egg is drying down properly. By the eighteenth day the air cell in the large end should be dried down to about 30 per cent of the total volume of the shell. To hasten the drying process, ventilation may be increased provided no drafts are produced. In case the eggs dry down too rapidly, the bottom of the incubator may be sprinkled, or a slight spray of water given the eggs.

After the eighteenth day the incubator is closed until the chicks are taken off. A slight film of moisture, on the lower edge of the inside glass, usually indicates that the air is of proper humidity for "pipping." As the chicks "pip" through their shells, they drop through the trays to the space below, known as the nursery. After they are about twenty-four hours old, they are removed to the brooders.

Electric Incubators.—These appliances usually consist of square or oblong cases mounted on wooden supports. They may be double walled with shoddy, mineral wool, asbestos, or other heat insulating material interposed, or single walled lined with heavy paper. Tight fitting double doors, the inner one always



Electro-Hatch 200 Egg Incubator

of glass, are provided along the front for examining the interior and moving the egg trays. These trays are made of either wood or metal and are inserted in the machine about four inches from the bottom. The heating elements are usually mounted near the top of the egg chamber, although in some makes of double deck incubators heating elements are placed near the bottom, as well as at the top.

Single deck types are claimed to be more satisfactory than double deck machines, on account of the more uniform heat that may be applied on a single plane. On the other hand, the double deck type requires less energy for heating a given number of eggs. In the single deck types provided with top heating units, the temperature is naturally higher above the eggs, and lower below them. The temperature in the nursery below the trays is therefore maintained at about 95° F., which is considered most desirable for newly hatched chicks.

The thermometers used in incubator work should be high grade instruments, because it is essential to know at all times just what temperatures are being maintained. A slight error in the thermometer will have a large influence on the success of the hatch.

Most of the thermostats that have been developed for use with electric incubators are extremely sensitive and are capable of maintaining the desired temperature to within ¼° F. to ½° F. These devices should be simple in construction, positive in action, and absolutely reliable, in order to insure the best results.

A well constructed single deck machine is generally provided with an average of about 75 watts heating capacity per 100 eggs. The average current consumption has been found to be about 10 kw.-hr per hundred chicks hatched. Incubators are now available that will hold from 30 to 1200 eggs.

Advantages of Electric Incubators.—An incubator heated by coal, oil, or gas is constantly filling the machine with fumes and burning up oxygen so essential to the germ life in the egg, whereas electricity neither destroys good air nor gives off bad air. The temperature control is simple and requires no attention, other than setting the thermostat by turning a thumb screw a couple of times during the hatch. The fire risk is entirely eliminated. The anxiety that attends the operation of fuel heated machines is done away with. The distribution of heat is perfect and the ventilation can be regulated at will. Much time and labor usually required in looking after fuel equipment is saved. The machines may be located in any convenient place and are adaptable to any climate. It is furthermore interesting to note that electrically hatched chicks always begin to pip about twelve hours quicker than those hatched by other artificial means. They are always stronger and more vigorous, and statistics show that a much higher percentage is hatched.

Relative Operating Costs.—The following comparative figures are taken from many averages secured in actual practice. They are based on an assumed incubator room temperature of 60° F. Although a rather low rate for electricity is required to make the actual operating cost comparable with those of some of the less expensive fuels, the savings effected, the better results secured, and the greater degree of satisfaction obtained by electric operation, will usually overcome whatever objection arises as to the cost of producing heat.

Relative Cost of Heat for Incubating.

Method of Heating.	Approximate Cost. Per 100 Eggs.
600 B.t.u. gas at $1.50 per 1000 cu. ft.	37c
600 B.t.u. gas at $1.00 per 1000 cu. ft.	25c
Coal oil at 20c per gallon	20c
Electricity at 5c per kw.-hr.	50c
Electricity at 3c per kw.-hr.	30c
Electricity at 2c per kw.-hr.	20c

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

(Much confusion has existed in the past regarding proper wiring methods for starting three-phase motors. Revised nomenclature for oil switches is still a matter of uncertainty with the contractor and dealer, while the subject of handling noise in ceiling fan motors is largely an unknown quantity. These items are all discussed in this department by the power apparatus specialist of the Western Electric Company at San Francisco, and should prove of timely use for the contractor and dealer.—The Editor.)

STAR-DELTA METHOD OF STARTING THREE PHASE MOTORS.

This method of starting is used to some extent with squirrel-cage motors which have their stator windings so arranged that they may be connected in star, or Y, for starting and delta for running. Separate stator windings are not required, but both ends of each phase must be brought out through the stator frame and a suitable switch must be provided to effect the change in connections. There are several special switches on the market for this purpose. It is also possible to use standard knife switches. Further details of these switches and their connections will be given later in this article.

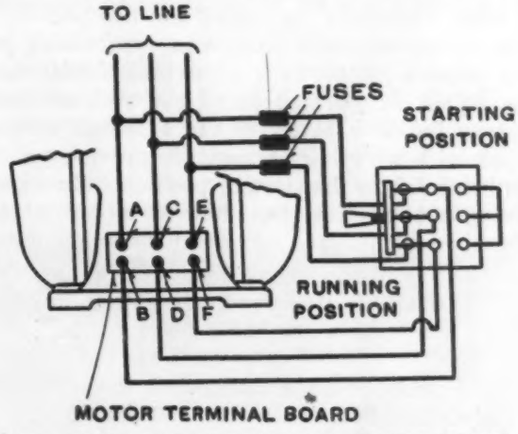
In starting, the switch is thrown into the starting position which connects the windings of the motor in star. When the motor has come partially up to speed, the switch is then quickly thrown to the running position which connects the windings in delta. The effect of connecting the windings in star during starting is to reduce the voltage applied to each phase winding to 57.7 per cent of full line voltage, while in the running position full line voltage is impressed across each phase of the winding. The starting torque and current will each be one-third the value obtained with the windings in delta.

Let us now apply these facts to an actual case. Take, for example, a certain 7½ h.p. 1200 rev. per min., 220-volt, 3-phase, 60-cycle, squirrel-cage induction motor. The full load running current is 19 amperes per phase. When this motor was started by being thrown directly across the line at full voltage the starting current at the instant of closing the switch was found to be 600 per cent of the full load current or $6 \times 19 = 114$ amperes, while the starting torque developed was equal to 180 per cent of full load torque.

Now suppose this same motor is started by the star-delta method. At starting, the voltage across each phase is 57.7 per cent of $220 = 127$ volts. The starting current will be 1/3 of $114 = 38$ amperes and the starting torque 1/3 of $180 = 60$ per cent of full load torque. If this torque is not sufficient to accelerate the motor, it will be necessary to either reduce the load on the motor or start it by some other method which will give higher voltage at starting and thereby develop a higher starting torque.

The starting torque of an induction motor varies quite widely, depending upon the size, speed, frequency and especially on the resistance of the rotor. For a squirrel-cage motor of the ordinary design, the starting torque will vary from about 100 to 200 per cent of full load torque when started at full line voltage while the line current will be from 5 to 7 times full load running current, which corresponds to about 3½ to 4½ times full load current for a starting torque equal to full load torque.

Here it is well to note that the starting current taken by a squirrel-cage motor at the instant of starting depends upon the voltage applied to its terminals. The duration of this current only, but not its value, is dependent upon the torque required to start the load. The current is maximum at the instant of starting but falls quickly to the value corresponding to the torque required by the load and then decreases gradually as the motor runs up to speed. Briefly this means that



Star-Delta Method Using Ordinary Knife Switch

the starting current of a motor is the same for a given voltage whether the motor is started without any load or against a heavy load. However, when starting against load the motor will come up to speed more slowly and therefore the heavy starting current will be maintained for a greater period of time.

The following tabulation gives the approximate starting torque and starting current, for a line of 60 cycle motors, obtained when starting the motors at full line voltage and when using the star-delta method. Both torque and current are expressed in per cent of full-load operating values:

No. of Poles in Motor.	Synchronous Speed.	Thrown Directly Across Line at Full Voltage. Torque.	Current.	Star-delta Method. Torque.	Current.
2	3600	180	490	60	163
4	1800	180	490	60	163
6	1200	175	485	58	161
8	900	165	480	55	160
10	720	150	430	50	143
12	600	140	400	47	133

From these figures it will be apparent that the starting torque under the star-delta method is insufficient except for easy starting service, especially in the slow speed machines.

In fact, this is one of the principal objections to this method of starting. These figures show what could be expected from an ordinary line of motors. However, the best results are obtained by designing motors especially for this method of starting. By doing so it is possible to increase the starting torque somewhat above the values here given.

A further disadvantage is that the starting torque in a given motor is fixed, whereas, when using a starting compensator it is possible to adjust the torque to suit the conditions.

From the manufacturing and designer's standpoint there are several important disadvantages. While these may not be of particular interest to many of our readers they will explain, partly, why motors wound for this method of starting are not more in general use. Perhaps the most important is that since motors of the same rating are built for several different voltages and many different ratings are built in the same frames with the number of stator slots unchanged, it is necessary that the connections of the stator coils should not always be limited to delta for normal running conditions.

The accompanying diagram shows the connections most commonly employed for this method of starting. The necessary change in connections from star to delta is made by a three-pole double-throw switch. This switch may be of the ordinary knife-blade type but it is better to use a switch which is equipped with a spring arrangement to prevent the handle being left in the starting position. By slightly modifying the connections, standard motor starting switches commonly used for small induction motors can be used for this purpose.

The fuses shown are for protecting the motor when running. It will be noted these fuses are not in the circuit when the switch is thrown to the starting position. Note also that a separate switch is necessary to completely disconnect the motor and starting switch from the line. This switch must always be provided, otherwise the installation would not be in accordance with the National Electrical Code.

Another article on this subject showing how the same results may be obtained with a single-knife switch will appear in a later issue. Suitable connection diagrams will be given. Also a new type of switch just placed on the market will be described.

REVISED NOMENCLATURE FOR OIL SWITCHES.

To agree with the definition given in the latest rules of the American Institute of Electrical Engineers, those devices formerly known as "oil switches" or "oil-break switches" are now called "oil circuit breakers." Article 724 in these rules describes a circuit-breaker as "A device designed to open a current-carrying circuit without injury to itself. A circuit-breaker may be (a) an automatic circuit-breaker, which is designed to trip automatically under any predetermined condition of the circuit, such as an underload or overload of current or voltage; (b) a manually tripped circuit-breaker, which is designed to be tripped by hand. Both types of operation may be combined in one and the same device."

Since there are also "air" circuit-breakers in the market, it will be necessary to avoid misunderstanding or confusion of terms, when referring to circuit-breakers, to state whether "oil" or "air" circuit-breakers are meant. The term "air" is used to distinguish carbon break and magnetic blowout types of circuit-breakers from oil circuit-breakers.

NOISE IN CEILING FAN MOTORS.

The noise produced by ceiling fans is probably the most common complaint registered against them. This is especially true of alternating current fans. Ordinarily a noisy fan is judged as being defective without any investigation whatever. The usual claim is that the bearings are out of alignment or something of that nature pertaining to them. However, this is now rarely the case. In most instances, the trouble will be found due to the method of installation or some other cause external to the motor itself. It is therefore good practice to carefully examine all parts likely to produce noise before attempting to locate the difficulty by removing the fan and taking it apart. This should always be done with the fan in its original position.

First of all the light metal parts on the hanger, such as the light shells covering the joint in the extension rod, should be examined. These may be sufficiently loose to vibrate or the canopy covering the insulated hanger eye may be loose and vibrate against the hanger. Vibration in the small shells covering the hanger joint can usually be remedied by bending them slightly with the hand until they are tight. If the trouble appears to be in the canopy at the top of the hanger, the set screw in the canopy should be tightened. If this does not remove the vibration it is then well to try wrapping a little friction tape around the hanger rod in such a manner as to prevent the metal parts of the hanger and canopy from touching.

If the noise is still noticeable, it may then be due to the manner or position in which the fan is suspended. Occasionally an alternating current fan is hung upon a ceiling which vibrates with the current, and which to a certain extent acts as a drum head, magnifying the vibration of the current. If this condition exists, it can be determined from the fact that in the room where the fan operates, no disagreeable amount of noise is apparent, but in the room above that in which the fan is hung, the noise will be much more noticeable, and sometimes very disagreeable. Where this condition exists, the trouble is not with the fan but is due to the manner in which the ceiling is constructed.

There does not seem to be a general method of eliminating the noise under these circumstances other than by removing the fan entirely, excepting that some times if the fan is moved to a different part of the ceiling the noise disappears.

Noise may also originate within the motor itself. Here it will generally result from worn bearings which sometimes allow the armature to move out of alignment and strike against the field. This trouble can be easily ascertained by inserting a small piece of paper in the air gap between the armature and field. In this connection it must be remembered that the clearance between the field and armature in a ceiling fan is exceedingly small and only a slight displacement is necessary to make trouble.

PACIFIC COAST N. E. L. A. SECTION JOTTINGS

(The recently established Pacific Coast section of the N. E. L. A. is already proving itself of active service to Western central stations. Herein may be found a current record of novel engineering, commercial and accounting practice among the membership of this organization. Contributions from all member companies are invited.—The Editor.)

St. Catherine's Well—a Corner at the Glenwood Inn.

SOME time during April the Pacific Coast N. E. L. A. Section is to hold its first convention. There are many places in the territory involved where a gathering might with profit be held and doubtless as the years roll on all of the various bidders for the honor of acting as hosts for the occasion will have an opportunity to have their hopes realized. In choosing the place for the initial gathering, however, unusual considerations must be carefully weighed before a final decision can be reached.

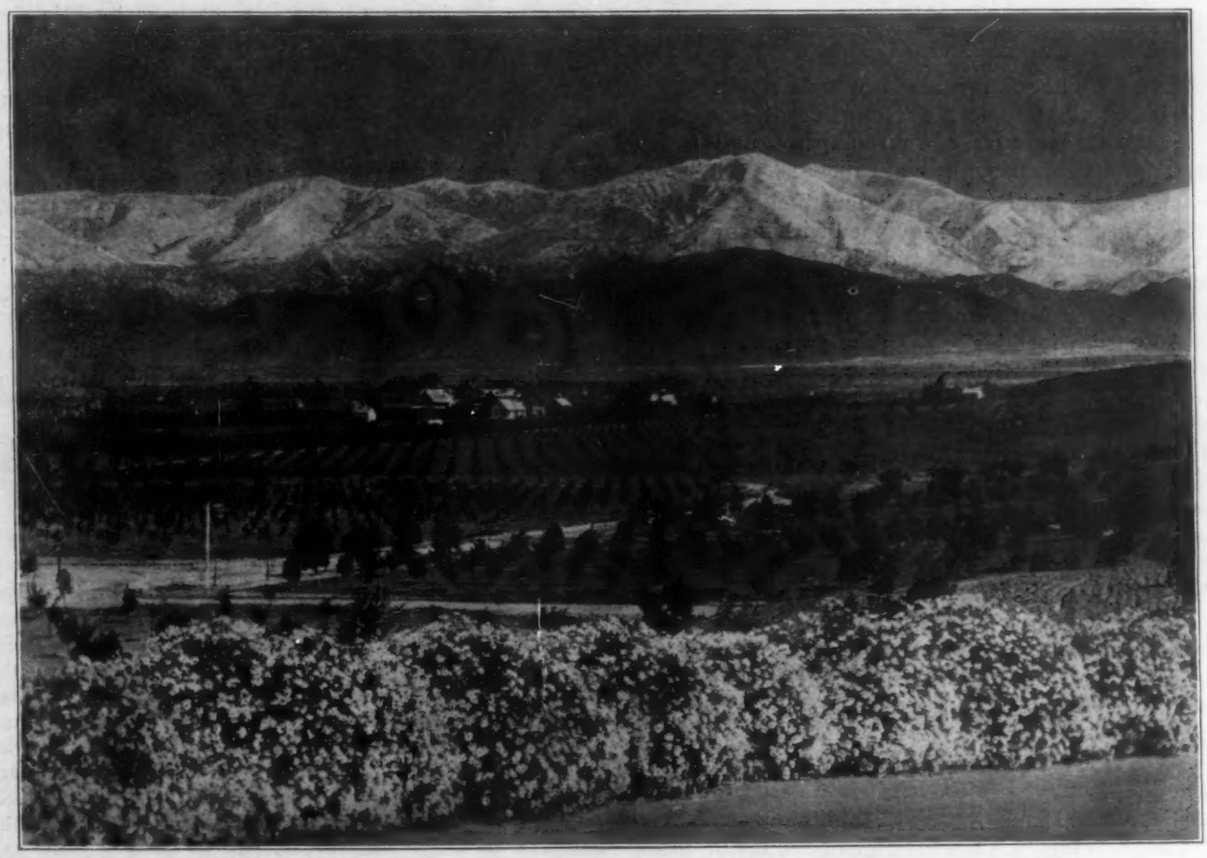
An Invitation to Meet at Riverside.

A. B. West, vice-president of the Southern Sierras Power Company has extended an invitation to the Pacific Coast Section to hold its first annual convention at Riverside in April. There are many reasons why the executive committee may accept this offer.

In the first place Riverside is of convenient access over three railroads from New Mexico, Arizona, California and Nevada. The Glenwood Mission Inn has excellent facilities for a convention, a fine hall, convenient committee rooms and excellent service. Mr. Frank Miller, master of the inn, has offered rates of $4 and $5 per day. Riverside has fine golf links, good tennis courts and beautiful automobile drives. It is the center of the longest high tension transmission system in the United Sattes and offers many points of technical and commercial interest to the electrical man.

Proposed Organization of Nevada Power Men.

J. G. Scrugham, dean of the engineering department at the University of Nevada and representative of the Elko-Lamoille Power Company at the organization meeting of the Pacific Coast Section is arranging for a meeting of the Nevada power men at Reno on March 3rd. At this time it is expected to organize a sub-section for the state and discuss ways and means



A Striking Scene from Riverside in Southern California. Marguerites in the Foreground, Citrus Fruits in all Directions and Snow-Capped Mountains in the Distance

for the development of greater irrigation developments under the auspices of the power companies.

An important feature of the organization meeting of the Pacific Coast Section of the National Electric Light Association at Los Angeles on January 6th was the decision to request the national association that the manufacturers be placed on a parity with the central station members at the option of geographic sections. The Manufacturer's advice in matters of public policy, engineering construction and commercial practice is exceedingly valuable to the power companies. It seems no more than fair that he should be given an equal voice in the conduct of the affairs of the association.

INTENSIVE LOAD BUILDING METHODS AT PHOENIX.

One of the most effective new business-getting methods of record is that employed by the Pacific Gas & Electric Company at Phoenix, Ariz. The company buys most of its power from the U. S. Reclamation Service whose hydroelectric plants at Roosevelt dam and along the line of its irrigation ditches afford good continuity of service. This supply is supplemented by a steam reserve plant which the company operates at Phoenix.

The keynote of the company's commercial policy is co-operation. The employes meet at frequent intervals in an assembly room and each is paid a dollar for so doing. As an erection pay system this has proven most satisfactory. Every man has been inculcated with the idea of constantly looking out for new business.

The most generally used appliance is perhaps the electric fan. The summers are hot and very few homes are without this comfort. A number of stories told by Mr. Aller, manager of the company, indicate the interest and enthusiasm of his men.

The negro janitor, became imbued with the selling spirit. His church was not equipped with fans and with an eye to his own comfort and also to the company's revenue, he concocted a little scheme with the church cornetist. One hot Sunday the cornetist started to play, stopped, wiped his brow, played a few more notes and sat down. He tried again, flourishing his bandana vigorously but without avail. At this stage of the proceedings our friend, the janitor, walked down the aisle with two fans which he connected and started, throwing the breeze on the cornetist. Immediately there was plenty of good music and as a result the fans are now operating regularly in that church.

One of the metermen, passing a residence, heard a child practicing its scales on the piano. It was a hot day and the child was probably uncomfortable. Going to the office the meterman got a fan, went back and rang the door bell. The child stopped playing and came to the door. "Good afternoon, I have a fan I would like to put on your piano." The deed was done. Two days later the meterman called. The mother met him at the door. " I left a fan here on trial the other day," he said. "I know you did," said the woman, "and now I have to buy it. My little girl gave me no peace till I promised to keep it."

As a result of such intensive methods during the past three years the company has put 1600 fans on its lines which were already considered saturated. In addition many fans were sold by the dealers.

A carnival in the town started its gas engine generating set close to the boarding house where one of the company's laborers lived. It kept him awake nights. He told his landlady he would have to move. She was sorry, but said that the engine stopped at 11 o'clock. He got several other men to complain. As a result Mrs. Landlady interested several of her neighbors to accompany her to the city council to complain of the nuisance. The power company connected up its lines to the carnival that afternoon.

The employes are encouraged to submit suggestions tending to improve the service. Three-fourths of these are good. For example one man found out that many consumers did not care to receive receipted bills. So a line was added, "Check here if you desire a receipt." The ensuing saving in postage alone has paid the entire cost of conducting the employes' meetings since then.

These several instances are cited as illustrating what a little personal interest will do in stimulating current consumption and improving service.

FIELD NOTES OF PACIFIC SECTION N.E.L.A. COMPANY PRACTICE.

Ontario, California, "the city that charms," has been put on the electrical map by the Hot Point Electric Company, which is demonstrating the feasibility of successful manufacturing under Pacific Coast conditions. All the current used by this company, together with the requirements of this thriving city of 2200 people is supplied by the Ontario Power Company from its hydroelectric plant in the mountains which tower 7000 ft. above the valley of orange and lemon groves.

Glenn D. Smith, general manager of the power company, firmly believes in the policy that satisfied patrons are a central station's best asset. Every attention is paid to popularizing the company and its service. Mr. Smith is a leader in the town's activities, was president of the Chamber of Commerce for four successive and successful years, and an always active worker in those matters advancing the community's welfare.

The following service letters addressed to all consumers are typical of his ideas in creating satisfied consumers.

Service Letter No. 1.

August 26, 1915.

To our Patrons:

It is the desire of the Ontario Power Company to have its service the best on the Pacific Coast. The management is constantly striving to reach that condition. Our patrons have doubtless noticed the gradual improvement in the service—the freedom from interruptions, uniform voltage and better illumination. The lack of complaints from our patrons during the past two years indicates that our service has been satisfactory. There may be places, however, where we can make further improvement and we ask the co-operation of our patrons in this work. It is the wish of the company to serve you as perfectly as possible, and any suggestions for betterment will be appreciated.

We will be glad of an expression from you as to the service you receive, and ask that you fill out the enclosed card and mail to us.

Yours for better service,

ONTARIO POWER CO.

Glenn D. Smith, General Manager.

Service Letter No. 2.

November 27, 1916.

To our Patrons:

Frequently electrical appliances are out of repair and the housewife is deprived of their use. These appliances usually can be easily repaired. It is the desire of this company to be of service to its customers and we maintain a Service Department that is ready to render assistance when needed. If you have any appliance that needs attention, telephone us and we will call for it and put it in condition for service. There will be no charge except where new parts are needed.

ONTARIO POWER COMPANY,

Glenn D. Smith, General Manager.

The first letter carried with it a reply postal card, and brought but twelve complaints from 2200 recipients. These were mostly with regards to low voltage, which was corrected at once.

The second letter has been most effective in keeping appliances in use which would otherwise lie idle. The devices are picked up by the solicitor in the regular course of business and are repaired by the substation attendant at odd times. Experience shows that most of the trouble is caused by broken cords, damaged heating elements coming next. Two or three devices are repaired every day and the central station revenue thus increased correspondingly.

Of the 2¼ million kw. hrs. sold annually, about one-third is for irrigation pumping, one-fourth for commercial power, one-third for lighting and one-sixth for heating and cooking. The last named is increasing rapidly, over two hundred consumers already cooking electrically.

The cooking consumption is encouraged by a regular range demonstrator who has conducted thirty-day demonstrations in Ontario and Uplands and is ready to visit any home at any time. One solicitor devotes all his time to this class of business, following up prospects furnished by the demonstrator.

Ranges are sold at the company's net cost, plus an installation and wiring charge of $5. Each range installed represents an average initial loss of $35 which is of course compensated by future current consumption. A combination rate is made for lighting and cooking,—nine cents for the first 20 kw.-hrs., three cents for the next 150, and two cents for anything in excess of 150, with 10 per cent discount for prompt payment of bills.

These practices are thus detailed as illustrative of a small company's opportunity to build a good load by pursuing broad-gauge policies.

Notes of Member Company Activities.

F. G. Russell, manager of the Tucson Gas, Electric Light & Power Company of Tucson, Arizona, has solved the question of central station merchandising and contracting by forming the Russell Electric & Machine Company, with E. E. Russell as manager. This arrangement relieves the power company of all requests for free installations, special prices on appliances and the like and provides the contracting company with a live list of prospects.

The Nogales Electric Light, Ice & Water Company of Nogales, Ariz., are installing a new 500 h.p. Busch-Sulzer Diesel engine to care for the growth in their load incident to the recent stimulation of business, due in part to the presence of the troops on the border.

The International Gas Company at Nogales, Arizona, have two 500 h.p. McIntosh & Seymour Diesel engines in satisfactory operation and contemplate the addition of a 1000 h.p. unit to care for the power demands of mining companies in the vicinity.

Pacific Section Committees.

President R. H. Ballard has announced the appointment of the following committees:

Engineering.

J. E. Woodbridge, Chairman; Sierra & San Francisco Power Co. San Francisco.
J. P. Jollyman, Pacific Gas & Electric Co., San Francisco.
H. A. Barre, Pacific Light & Power Corp., Los Angeles.
L. M. Klauber, San Diego Cons. Gas & Electric Co., San Diego.
John Koontz, Great Western Power Co., San Francisco.
C. O. Poole, The Southern Sierras Power Co., Riverside.
Jas. A. Shepard, Deming Ice & Electric Co., Deming, New Mex.

Commercial.

S. V. Walton, Chairman; Pacific Gas & Elec. Co., San Francisco.
A. W. Childs, Southern California Edison Co., Los Angeles.
E. B. Criddle, The Southern Sierras Power Co., Riverside.
L. H. Newbert, Pacific Gas & Electric Co., San Francisco.
E. B. Walthall, San Joaquin Light & Power Corp., Fresno.
C. M. Einhart, Roswell Gas & Electric Co., Roswell, New Mexico.
J. B. Black, Great Western Power Co., San Francisco.

Accounting.

W. E. Houghton, Chairman; Los Angeles Gas & Electric Corp., Los Angeles.
M. H. Bridges, Pacific Gas & Electric Co., San Francisco.
M. B. Fowler, San Diego Cons. Gas & Electric Co., San Diego.
C. E. Mynard, Great Western Power Co., San Francisco.
B. B. Smith, Western States Gas & Electric Co., Stockton.
B. T. Story Southern California Edison Co., Los Angeles.

Additional representatives are to be appointed from Arizona, New Mexico and Nevada at a later date.

The electrically operated pump has this year found immensely profitable application in the irrigation of bean crops. The harvest of black-eye and other varieties of beans is just about completed in the Stevinson section of Merced County, of California, the yield being approximately 50,000 sacks. There are also several thousand sacks of Egyptian corn which will add materially to the wealth of that colony.

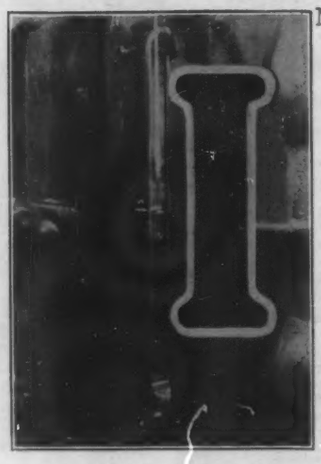
The installation of electrically operated dredges at Hanlon Heading on the Colorado River, about seven miles below Yuma and on the California side, has created much interest. It is here that the immense volume of water required for irrigation purposes in the Imperial Valley is taken from the river, and at certain seasons of the year serious loss is caused the farmers by the silting up of the canals and the corresponding water shortage. To remedy this annual condition the Imperial Irrigation District has arranged for the installation of two and possibly four electrically operated dredges of 650 h.p. each, the power for which is to be furnished by the Coachella Valley Ice & Electric Company, which is a subsidiary of the Southern Sierra Power Company. A sixty-mile 55,000-volt transmission line is now being constructed between El Centro and Hanlon Heading, and it is expected that the dredges will be in operation by April 15, 1917.

FUEL OIL AND STEAM ENGINEERING

(The subject of pressures and their proper computation is one of endless confusion in fuel oil and steam engineering practice. In this article the relationship of gage pressures with absolute pressures and the establishment of what the thirty inch vacuum really means, so often misunderstood in engineering discussion, is lucidly treated together with methods for making proper corrections when readings of the barometer are taken.—The Editor.)

THEORY OF PRESSURES IN FUEL OIL AND STEAM ENGINEERING PRACTICE.

BY ROBERT SIBLEY.



The Thermometer Suspension for Barometer Correction

IN the preceding discussions we have seen that a force is said to be acting whenever the physical conditions are such that the velocity of a body tends to be changed in magnitude or direction. If two opposing forces are equally balanced, there is simply a tendency to change motion and such a force is known as a pressure. This opposing force in the case of a gas or vapor under pressure is supplied by the walls of the containing vessel. Pressures then constitute an important phase of steam engineering practice.

The Steam Gage.—In steam engineering practice heavy pressures, that is pressures above the atmosphere, are usually measured by means of an instrument known as a steam gage. This gage consists of a piece of hollow metal bent into a circular shape which, under pressure, tends to straighten out. This straightening effect is proportional to the pressure under which the boiler is working. A rack and pinion movement, placed on the end of this curved piece of metal in the steam gage, causes the needle of the gage to indicate pressure readings. By comparing this gage with a definite standard its accuracy is ascertained.

The Difference Between Absolute Pressure and Gage Pressure.—There is a point at which a gas is said to exert no pressure. This expanded condition of a gas has never been wholly realized in practice, yet this very beginning point or zero value is most convenient in expressing pressure valuations and such denotations are known as absolute pressure values. The steam gage attached to the boiler does not read absolute pressure values, but such pressure readings are known as pounds pressure per sq. in. (gage) which means that one must add the absolute pressure of the atmosphere, P_a, to the gage reading, P_g, in order to ascertain the true absolute pressure P under which the boiler is generating steam. Thus

$$P = P_a + P_g \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

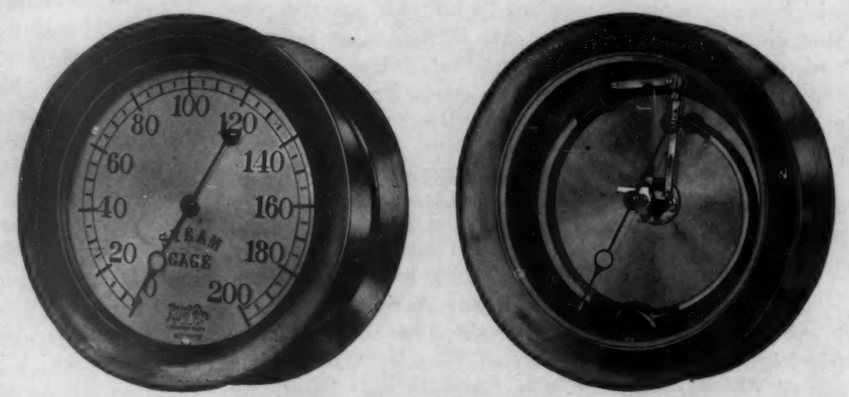
Thus, if a pressure gage of the steam boiler reads 186.4 lb. per sq. in. and the pressure of the atmosphere is found to be 14.6 lb. per sq. in., the absolute pressure under which the boiler is operating is

$$P = 186.4 + 14.6 = 201.0 \text{ lb. per sq. in.}$$

The Column of Mercury.—The most accurate method of measuring small pressures such as the pressure of the atmosphere and condenser vacuum pressure is by means of a vertical column of mercury. In its simplest form this consists of a long glass tube closed at one end and filled with mercury. The tube is then inverted and the open end placed in a vessel of mercury exposed to the atmosphere or condenser as the case may be, as shown in the illustration.

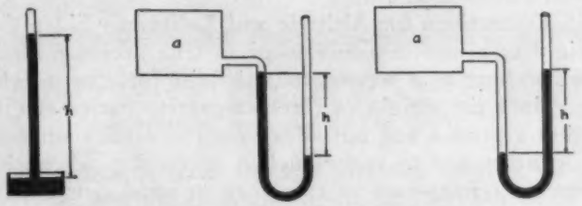
In the case of atmospheric pressure determination the mercury will at once lower itself in the long tube until the height of enclosed mercury above that in the vessel is sufficient to balance the pressure from the atmosphere without. If the barometer be at sea-level and the temperature of the mercury column 32° F., the height of mercury will now measure exactly 29.921 inches for such standard conditions.

Vacuum Pressures.—It has already been pointed out that measurement of pressure by means of the steam gage indicates a pressure over and above that exerted by the atmosphere and consequently to ascertain the true absolute pressure of the fluid under measurement we must add to the gage reading the atmospheric pressure of the day. And so in the measuring of the pressure of a condenser, unfortunately there has grown up a similar but opposite custom in which the pressure is measured down from the atmosphere. Such



Exterior and Interior View of Steam Gage, showing Principle of Operation

a reading is known as a vacuum pressure. In order then to ascertain the absolute pressure **P** under which a condenser is operating it is necessary to subtract



The Principle of the Atmospheric Rarometer, the Condenser Vacuum and the Measurement of Pressures above the Atmosphere

the vacuum pressure reading P_v from the atmospheric pressure reading P_a. Thus

$$P = P_a - P_v \quad \ldots\ldots (2)$$

Thus if a condenser is operating under 28.5 in. of vacuum and the atmospheric pressure is 29.92 in., we mean that the actual air and steam still undisposed of in the condenser exert an absolute pressure equivalent to the difference of 29.92 and 28.50 which is 1.42 in. of mercury.

Confusion in Pressure Units.—We now see that readings in inches of mercury for low pressures and pounds pressure per sq. in. for high pressure are expressions that are not at all comparable to each other and hence their interrelation becomes an endless source of confusion.

Relationship of Pressure Units.—By careful measurement of the atmosphere at sea-level, scientists have established that the height of a mercury column with the mercury at 32° F. in temperature is 29.921 in. Such a column of mercury one square in. in cross-section weighs 14.696 lb. This gives us at once a method by which we may transfer inches of mercury I_m into pounds of pressure per square inch **P**. Thus

$$\frac{I_m}{P} = \frac{29.921}{14.696} \quad \ldots\ldots (3)$$

Inches of Water and Pounds Pressure per Square Inch.—Very slight pressures are often measured in inches of water above or below atmospheric pressures. Thus, in determining the draft of a chimney, a "U" tube is inserted into the chimney, and the height of the unbalanced portion of the water column indicates the draft in the chimney in inches of water. Since a column of water 1728 in. high and one square inch in cross-section at 100° F. weighs exactly 62 lb., the inches of water I_w may be converted into lb. pressure per sq. in. **P** by the formula

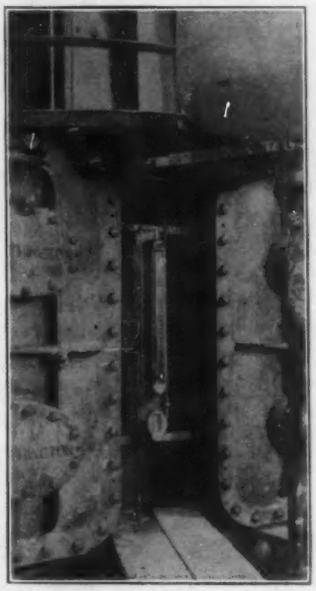
$$\frac{I_w}{P} = \frac{1728}{62} \quad \ldots\ldots (4)$$

The Thirty Inch Vacuum.—In engineering practice a thirty inch mercury vacuum is considered to be the point of absolute zero in pressure. This is not strictly true, however, for we have just seen that such an absolute zero point is reached under a vacuum pressure of 29.921 in. of mercury. The reading of the column of mercury in this case is taken when the mercury is at a temperature of 32° F., which is the standard temperature for scientific measurement. If, however, we change our standard to that of 58.4° F. the same weight or pressure of mercury now measures just 30.0 in. This temperature is more nearly that of the condenser room where atmospheric pressures are read and since it makes a column of even thirty inches in height, we shall adopt such a reading at 58.4° F. as standard for absolute vacuum measurement. We shall, however, bear in mind that the same column at 32° F. would stand at 29.921 inches.

The Practical Formula for Conversion of Pressures—Since we have thus established an even unit for the standard vacuum, we may also consider 14.7 pounds pressure per square inch as its equivalent instead of the cumbersome figure of 14.696 as stated above. This involves an error of four points in fifteen thousand which is negligible. Our formula for reduction on the thirty inch vacuum becomes

$$\frac{I_m}{P} = \frac{30}{14.7} \quad \ldots\ldots (5)$$

To Reduce Barometer Readings to the Standard Thirty Inch Vacuum.—Although 58.4° is nearer the condenser room temperature than is the 32° F. basis, still for accurate measurement the actual temperature of the medium surrounding the mercury column should be ascertained and thus a correction must be made to reduce the height of the mercury column to what it would read if at a temperature of 58.4° F.



The Typical Condenser Barometer for Steam Turbine Operation

This is best illustrated by taking a concrete example. Let us suppose that the mercury column inserted into the condenser of a turbine reads 28.56 in. when the mercury temperature is 82° F. and that a barometer in the vicinity indicates the atmospheric pressure in the condenser room to be 30.08 in. of mercury when its mercury column is at 78° F.

The first thing to be done in the solution of this problem is to ascertain what the two mercury columns would have read had their respective mercury columns been at 58.4° F. Scientific investigation indicates that the expansion of mercury is according to the following equation in which I_t is the height in inches of mercury at t° F. and I_m at 58.4° F.

$$I_t = I_m [1.0026 + .000104 \ (t - 58.4)] \quad \ldots\ldots (6)$$

Hence, to ascertain the true vacuum reading in inches of mercury we find by substitution

$$28.56 = I_m [1.0026 + .000104 \ (82 - 58.4)]$$

$$\therefore I_m = 28.415.$$

Similarly to compute the corrected barometer reading of the day, we find by substitution that

$$30.08 = I_m\ [1.0026 + .000104\ (78 - 58.4)]$$

$$\therefore\ I_m = 29.942.$$

The net absolute pressure will now be the difference between the corrected atmospheric barometer reading and the corrected vacuum reading for the condenser, which according to equation (2) is

$$29.942 - 28.415 = 1.527 \text{ in. of mercury.}$$

Since all standard vacuums in engineering practice are now measured on a 30 inch vacuum basis, we find that the corrected vacuum reading I_{cv} for a condenser is

$$I_{cv} = 30 - I_p \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$\therefore\ I_{cv} = 30 - 1.527 = 28.473 \text{ in. (vacuum).}$$

For delicate scientific work this reading should be carried to still further refinements by making a correction for the expansion of the brass on the barometer scale and also for a variation in gravity at the particular place of measurement. At high altitudes and extreme northern and southern latitudes such a correction is essential.

Corrections for the Brass Scale of a Barometer.—Professor Marks in his computation of steam tables for condenser work published by the Wheeler Condenser and Engineering Company has ably discussed the correction for relative expansion of mercury and the brass scale of the barometer as follows:

A hand Adjuster for the Steam Gage

The linear expansion of brass is about one-tenth that of the apparent linear expansion of mercury exerting a constant pressure. Where a mercury column has a brass scale extending its whole height which is free to expand with changes in temperature, the readings on the brass scale of the height of the mercury column must be corrected for the relative expansion of the mercury and the brass scale. The following table is taken from table 99 of the Smithsonian physical tables and gives the constants for various barometer heights by which to multiply the temperature correction in order to obtain the corrections of the mercury column.

Reduction of Barometric Height to Standard Temperature Corrections for Relative Expansion of Mercury and Brass Scale.

Height of Barometer in inches.	Correction in inches per deg. F.	Height of Barometer in. inches.	Correction in inches per deg. F.
20.0	0.00181	28.0	0.00254
20.5	.00185	28.5	.00258
21.0	.00190	29.0	.00263
21.5	.00194	29.2	.00265
22.0	.00199	29.4	.00267
22.5	.00203	29.6	.00268
23.0	.00208	29.8	.00270
23.5	.00212	30.0	.00272
24.0	0.00217	30.2	0.00274
24.5	.00221	30.4	.00276
25.0	.00226	30.6	.00277
25.5	.00231	30.8	.00279
26.0	.00236	31.0	.00281
26.5	.00240	31.2	.00283
27.0	.00245	31.4	.00285
27.5	.00249	31.6	.00287

Example: Reading of barometer 29.84, temperature of barometer 77° F. In the foregoing table the nearest figure to 29.84 is 29.8 opposite which the correction factor is .0027. If it is desired to reduce the barometer to a 58.4° F. standard, the change in temperature is from 79° to 58.4° = 20.6° and multiplying .0027 by 20.6 we get .056 inches as the barometer correction. Subtracting this from 29.84 in. we get the barometer reading for mercury at 58.4° F. as 29.84 in. — .056 in. = 29.784 in.

Corrections for Altitude and Latitude.—Since the height of a mercury column gives true pressure readings so long as it represents a definite force or weight and since the weight or force of gravity varies at different altitudes and latitudes over the earth's surface, it is necessary to enter such a correction when the extreme refinements of the work in hand demand it. The standard value of gravity is taken at 32.173. The following formula, in which I_{mg} is the correct reading, **g** is the gravity coefficient, λ the latitude, and **h** the altitude at the point of pressure measurement, may be applied for this correction.

$$I_{mg} = \left[\frac{32.173 - .082\ \text{Cos}2\lambda - .000003\ h}{32.173}\right] I_m \quad \ldots (8)$$

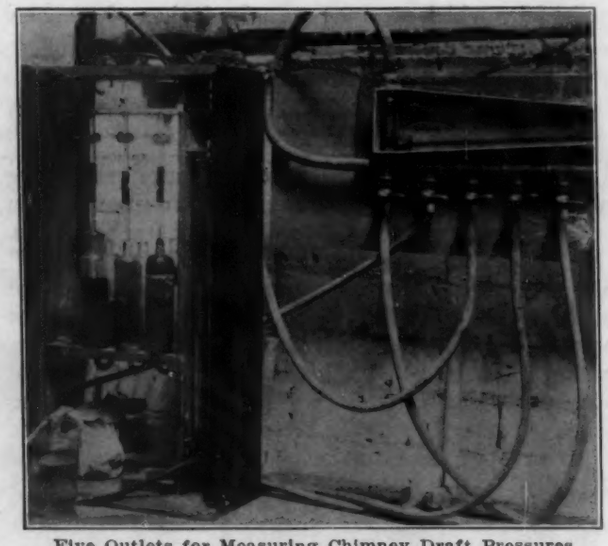
Thus in a certain engineering investigation in Berkeley, California, where the latitude is 38° and the elevation 50 ft., the condenser barometer corrected for temperature read 28.473 in. What should its properly corrected reading be when gravity is taken into consideration?

By substitution

$$I_{mg} = \frac{32.173 - .082 \times .2419 - .00015}{32.173} \times 28.475$$

$$= \frac{32.153}{32.173} \times 28.473 = 28.464.$$

Such refinements as the one for brass scale correction and especially for latitude and altitude readjustments are not necessary in most steam engineering tests. It is well, however, to bear in mind such computation in case investigations of extreme detail should arise.



Five Outlets for Measuring Chimney Draft Pressures with One Draft Gage

Errata are to be noted in the problem given on page 52 of the issue of January 15, 1917. The piston area should be 113.15 sq. in. and the mean effective pressure 77.3 lb. per sq. in. for the 50 h.p. Diesel engine cylinder there cited.

SPARKS—Current Facts, Figures and Fancy

(The world today is full of facts and figures of tremendous interest to Western engineers. Here are some boiled down items noted from a survey of thirty current magazines that should prove of interest to our readers.—The Editor.)

The income from sales of electrical energy during 1916 totaled the enormous figure of over four hundred millions of dollars.

* * *

It is estimated that in 1915 about forty thousand forest fires occurred in the United States, which burned nearly six million acres and caused a damage of approximately seven million dollars.

* * *

Exports of paper for 1916 reached the forty million dollar mark, doubling those of any previous year. No wonder technical journals find the paper required for publication purposes has gone up one hundred and fifty per cent.

* * *

The close of 1916 showed that the Public Employment Bureau of the State of California had found over forty-six thousand positions for men and women during the eleven months the state had been in the employment business.

* * *

Electric propelling machinery has been ordered for the seven latest American battleships and is specified for the four great new battle cruisers as the electric drive is considered to be superior to any other known method of propulsion.

* * *

Julean Arnold, American commercial attache to China and Japan forcefully advises American manufacturers and engineers to get the map habit and become more familiar with the location of foreign countries and their position relative to America.

* * *

The common wood box finds application in every industry. Tests at the Forest Products Laboratory, at Madison, Wisconsin, indicate that by the use of four additional nails in each end an increase of 300 per cent in the strength of canned-food boxes is secured.

* * *

Revised estimates place the amount of standing merchantable timber in the United States at approximately 2,767 billion board feet. Of this amount 1,464 billion board feet, or fifty-three per cent of the total, is in California, Washington, Oregon, Idaho and Montana.

* * *

The first extensive wireless telephone system in the world is now being put into use in Southern California on the large reserves of the Forest Department of the United States, where the inventor will be at work on the perfection of the system during the entire winter.

The United States Department of Agriculture is erecting at Summerland, California, a plant costing about one hundred and fifty thousand dollars for recovering potash from seaweed. Electrochemical industries of all kinds have unusual promise of success on the Pacific Coast.

* * *

A unique exhibit on "Home made" city planning has been prepared by George A. Damon, Dean of Engineering, Throop College of Technology in Pasadena. Coming as it does from an engineer of wide experience in municipal railway and traffic problems the exhibit is of especial interest to engineers generally.

* * *

Seventy-five thousand acres of rice were planted in California in 1916, but owing to the damage done by early rains and heavy winds only about 60,000 acres were harvested. The first sales reported were for $1.75 per hundred but the farmers are holding their stock in the anticipation of a two-cent rate. Meanwhile the electrical load for rice irrigation grows apace.

* * *

The reports do not state whether hydroelectric agricultural development had anything to do with it or not, but any rate Spider Kelly, a well-known thoroughbred steer in California recently sold for one dollar and seventy cents per pound, live weight, the highest price ever paid for a champion steer at the International Livestock Show in Chicago. In no other instance of record has beef been the highest—except when the "cow jumped over the moon."

* * *

On many of the national forest ranges across which high voltage transmission lines pass, there are areas in which various poisonous plants occur in more or less abundance. Each year the owners of live stock using the ranges lose approximately three hundred thousand dollars by the death of animals which eat these poisonous plants. In line with its other efforts to better the national forest range, the Forest Service is undertaking the eradication of the plants which cause this loss.

* * *

Dean David P. Barrows of the University of California contributes an article to the January number of the students' "California Law Review" entitled "Legislative Failure and Reform." Here he advocates a radical reorganization of the state legislature. He proposes a one-chamber body which shall meet every year. His plan calls for a permanent body chosen by the legislature to supervise and regulate the introduction of bills.

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Fuel Oil Becomes an Industrial Problem

A year's review of the fuel oil market reveals the fact that the constantly advancing price of this product bids well to become a serious industrial problem.

As a consequence of an increasing demand for oil and a decrease in the storage quantities held by the pipe-line companies and purchasing agents, the market for all grades of petroleum produced in California was uniformly strong throughout the year just past. During 1916, according to the reports of the U. S. Geological Survey, the quotations posted on December 28, 1915, remained in effect until February 16, when all grades except Ventura County were advanced ten cents. A further advance of five cents, posted April 1, likewise affected all grades except Ventura County. Again, subsequent advances of five cents each, involving all grades of oil produced in the state, became effective on September 20 and November 21.

Thus the climb in market prices has been steadily upward. A moderate increase in production has been the response of California oil fields to the steady advance in prices. Drilling activity in all fields has been nearly twice as great as in 1915, but the size of the new wells completed contrasted strongly with those of three or four years ago.

Although the scarcity of oil of fuel grades has resulted in especial activity in the Kern River and McKittrick fields, still central station managers of the West are at this moment seriously pondering with much apprehension the problem of economic power development for the future.

Many claims and counter claims are being made as to the reason for the present apparent falling off in California oil production to meet the increased demand.

It is openly argued that the governmental withdrawal of oil lands for naval purposes is the cause. Others say the companies themselves are holding back the output of their best wells.

Whatever the cause is, the effect is liable to be too serious to allow idle manipulation and proper steps should be taken at once to find out the truth in the matter.

The Engineer and the New America

Like Rip Van Winkle, citizens of the United States are daily awakening from a long oblivious dream and in gazing about over the Western Hemisphere countless changes are to be observed that have taken place since the early establishment of the Monroe Doctrine and the sole guarantee by the United States of the stability of the new world discovered by Christopher Columbus.

The growth of countries to our north and south during the past twenty years has been almost a miracle. Engineers and captains of industry in the United States during this period were so busily employed that it took the cannonading of a world war to bring them to a realization of the new world factors that now are to enter into all new undertakings.

Here, for instance, is a little incident insignificant in itself yet illustrative of the new America that now must be reckoned with in future engineering and commercial matters.

A book has just been written, reviewed elsewhere in this issue, dealing with a record of an American government in the management of its telephones. At first glance we of the United States wonder in which one of the forty-eight states this government is located and it is with some dismay perhaps that we find its location is claimed in Canada.

In a word an American citizen can not longer in this broader sense be considered necessarily of the United States for some fifteen other independent states may with equal right claim this distinction.

The incident serves one important purpose and that is the all importance of every citizen of the United States getting the map habit. To engineers of the West, this is of unusual emphasis. The new field of activity of engineers of the West will undoubtedly cover many of the American countries bordering the Pacific.

And to properly render the higher ethical service demanded by his profession the new engineer must fully appreciate what it is to be in its broadest aspects a true American citizen.

Convict Labor and Hydroelectric Installation

More and more it is coming to be recognized by all students of civic economy that the convict may under proper guidance render aid to the state that will not only prove of financial assistance to its citizens but will immeasurably raise his own self-respect and keep alive the flame of possible future usefulness during his period of sentence serving.

Several commonwealths of the West have already demonstrated this fact in the employment of convicts upon certain of the public highways under a system of merit which has proved most encouraging for future application of the principle of reward in prison work.

Now comes the test for convict labor in hydroelectric installation. On another page of this issue may be found a description of the new power plant recently put into operation at the Folsom state prison in California. This installation, though small in actual output, yet possesses many interesting features. In the first place it probably establishes a new record for utilization by low heads in hydroelectric development. And in the second place convict labor was used throughout in the work involved. It is interesting to learn that the work proceeded with rapidity and without accident. All of which goes to show that under enlightened treatment, tact and discretion, the convict may become a useful economic factor in an ever-increasing number of instances where the state is in need of labor and where the convict is available to perform it.

Radio Operation for Transmission Lines

Radio telegraphy and telephony are coming to the front as important means for the protection of long distance transmission lines in times of emergency. In the case of heavy storms with the resultant damage to high tension transmission lines and the consequent interruption of service the telephone line usually goes out of commission along with the other apparatus involved.

California, the home of the long distance hydroelectric system of transmission seems to be taking the lead in evolving new and reliable means for insuring continuity of service at such times by providing a method of communicating intelligence that is independent of wires.

The continued application of radio telegraphy and telephony to problems of high voltage transmission will undoubtedly make even still more efficient the excellent continuity of hydroelectric service throughout the West.

The Southern Sierras Power Company of California has been conducting extensive experiments with the wireless telegraph as a means of communication between its power plants and substations. These have been so successful as to make probable the ultimate replacement of the present system of wire telegraphy by the wireless.

It has already been proven that the transmission line makes a most effective guide for the wireless waves. Furthermore, it is hoped to detect trouble on the line by changes in the sound given by the audion detector. Defective switches have already been located by this means, and the indications are that other sources of trouble can be located in like manner.

The evident increased service that radio transmission is about to render to the industry whence it has sprung adds again another emphatic argument against governmental control of this importance adjunct to continuity of service in the transmission of electrical energy.

Commercial Engineering in South America

Increased foreign engineering effort on the part of American engineers must of necessity go hand in hand with development of closer commercial relations with neighboring countries to the north and south.

Combination in so far as foreign effort is concerned does not in so exaggerated a manner act in the nature of restraint of trade as it does in affairs at home. In view of this fact certain legislation is now before the congress of the United States to legalize combinations so that an effective and united front may be offered to foreign competitive forces in the field and thus put further home products in the foreign field that otherwise could not be financed sufficiently to bear the high cost involved were they placed upon the foreign market single-handed and alone.

On another page of this issue is recited an interesting meeting of leading manufacturers of the United States wherein effective methods have been adopted thus put forth home products in the foreign field that to properly exploit American made goods in the profitable markets of the Argentine.

Certain of the European countries acquired their strong footing in South America prior to the present war by financing many of the daring yet feasible engineering feats that have in recent years been wrought there. It is sincerely to be hoped that American engineering talent will similarly be employed in this new field of opportunity and thus strengthen the firm commercial relations that are each day increasing in importance between the United States and the countries to the south.

PERSONALS

A. S. Kalenborn, electrical engineer of the San Joaquin Light & Power Corporation, of Fresno, Cal., was a visitor at San Francisco recently.

C. L. Cory, professor of electrical engineering at the University of California, has again assumed his collegiate duties, after a six months' leave of absence in the East.

C. G. A. Baker, vice-president and treasurer, Baker-Joslyn Company of San Francisco, after the Jobbers' Convention at Del Monte, left for a short business trip to Los Angeles.

L. G. Cushing, factory representative of the Connecticut Electric Company, recently arrived at San Francisco from Portland, Ore., on a tour of inspection. He intends to visit Los Angeles on his return trip.

W. K. Brown, district manager of the Crocker-Wheeler Company at San Francisco, has left for Ampere, N. J., where he expects to attend the sales manager's convention of his company which opens February 9th.

S. T. Harding, assistant professor of Irrigation Institutions at the University of California and a well-known contributor to the Journal of Electricity, has returned from an extended tour of investigation in the Northwest.

Albert Holmes, formerly purchasing agent with the Electric Appliance Company, San Francisco, resigned his position after 12 years' service with this company. He was also formerly assistant cashier of the Central Electric Company of Chicago.

Albert S. Hall, manager of the Hood River Gas & Electric Company, also the Hydroelectric Company of Hood River, Oregon, has resigned to become district manager of the Pacific Power & Light Company at Pasco and Kenewick, Washington.

Ross Hartley, formerly district manager of the Pacific States Electric Company of Portland and Seattle and well known in electrical circles up and down the coast, is now affiliated with the Illinois Electric Company of Los Angeles in the capacity of credit manager.

Arthur Morgan, a consulting engineer of Dayton, Ohio, in charge of the mammoth flood prevention work now under way on the Miami River, was a recent visitor on the Pacific Coast and has inspected the progress of work upon the Calaveras Dam of the Spring Valley Water Company.

E. G. Robinson, formerly general manager of the Washington Coast Utilities, and a past president of the Northwest Electric Light & Power Association, has purchased the Molalla Electric Company of Canby, Oregon, which serves light and power for the towns of Canby, Barlow, Aurora, Hubbard and Donald. Mr. Robinson will devote his time to the management of his new activities.

Luis Matte Larrain, in company with **Herman Lois,** civil engineers of Santiago, commissioned by the government of Chile, have recently arrived from the south and in company with **Horacio Johnson,** Chilean Consulate of San Francisco, will make a four month's inspection tour of the United States where they will study the hydroelectric and water situations in this country.

C. H. Johnson, for many years with the Western Electric Company in charge of the pole business, has recently accepted a position as sales manager on the Pacific Coast for the National Pole Company of Escanaba, Mich., with offices at San Francisco. This company has taken over the yards of the Western Electric Company in Oakland and will operate them with complete stock of all sizes of cedar poles. Mr. Johnson also intends to handle his old line of Carbolineum and the pole construction specialties of the Specialty Device Company of Cincinnati, Ohio.

G. D. Mantle, formerly with the Portland Gas & Coke Company at Portland and for years, sales manager Northern Electric Company at Vancouver, has recently been appointed sales supervisor for the Pacific Gas & Electric Company, with San Jose, Contra Costa, Redwood City and San Joaquin as his territory. **H. M. Crawford,** formerly district agent for the San Joaquin Street & Power Company at Bakersfield, has recently been appointed sales supervisor with Marin, Sonoma, Santa Rosa, Napa and Vallejo, as his territory. **H. C. Ross** has been appointed sales supervisor of Sacramento, Dixon, Yolo, Marysville, Chico, Auburn and Grass Valley.

George F. Haller, vice-president and general manager of the Haller-Cunningham Electric Company, of this city, has just returned from a four weeks' trip to the Atlantic and Gulf seaports. He went East to arrange for the installation of one of their wireless equipments on the steamer "Malmanger," being built at Chester, Pa., for Norwegian owners. He succeeded in closing contracts for a number of additional Norwegian and American steamers. This business together with business recently closed on the Pacific Coast, will keep the Haller-Cunningham force working well into the fall months at full capacity. The Haller-Cunningham wireless equipment is sold outright and is not leased, as has been the practice heretofore. This system has been developed on the Pacific Coast by G. F. Haller and is protected by extensive patents. This is another example of a California product being accorded wide Eastern recognition.

TRADE NOTES.

The new 1917 Diary Book of the Westinghouse Manufacturing Company has made its appearance in the trade, where its useful general information and blank spaces for business notations are finding an unusually hearty welcome.

John Woods Beckman and Herbert Emil Linden announce the formation of the Beckman & Linden Engineering Corporation for the purpose of undertaking the development and management of chemical, metallurgical, electrochemical and electrometallurgical industries, as well as hydroelectric enterprises. Their offices are in the Balboa Building, San Francisco.

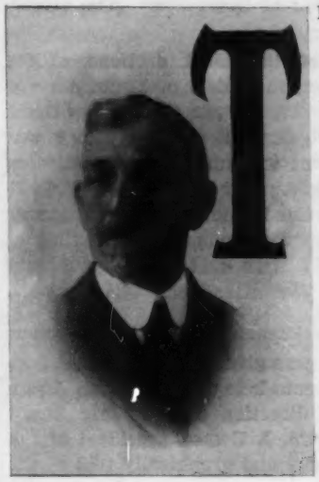
William A. Cattell, Henry S. Howard and Raymond Ashton announce their association under the firm name of Cattell, Howard & Ashton, engineers. The firm is prepared to undertake engineering work in connection with the following: Steam and electric railroads, bridges, buildings, foundations, harbors and terminals, water supply and irrigation systems, industrial and manufacturing plants, sewers and sewage disposal, power developments and valuations. Their address is 68 Post street, San Francisco, California.

Samuel G. Hibben, formerly head of the engineering department of the Macbeth-Evans Glass Company of Pittsburgh, Pa., and associated with the Westinghouse Electric & Manufacturing Company, has recently become identified with the Westinghouse Lamp Company. Mr. Hibben is well known in the several electrical and engineering organizations, and particularly for his activities in the Illuminating Engineering Society, being chairman of the Pittsburgh Section. He has also been engaged in consulting work in the lighting of a number of large buildings. With the lamp company he will continue in the engineering work, furnishing expert lighting advice to the various users of Westinghouse Mazda lamps. Mr. Hibben will have his headquarters at the Pittsburgh office.

MEETING NOTICES FOR ELECTRICAL MEN

(The constant getting together of men in the electrical industry of the West has played an unusually large part in developing the now universally recognized esprit de corps that exists in this section of the country among men of this industry. Here is an account of a farewell to a prominent electrical jobber that illustrates how this underlying spirit adds much to the life and enthusiasm of electrical progress on the Pacific Coast.—The Editor.)

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION.



Samuel H. Taylor

THE meeting of the Electrical Supply Jobbers' Association held at Del Monte January 11, 12 and 13, 1917, was the largest meeting that the Association ever held. The recent regrouping plan by which Salt Lake City, Butte and Spokane were added to the Pacific Coast Division resulted in bringing into the Association three main houses, to wit: Inter-Mountain Electric Company of Salt Lake City, represented at the meeting by C. B. Hawley, Capital Electric Company of Salt Lake City, represented at the meeting by R. S. Folland and Montana Electric Company of Butte Montana, represented at the meeting by H. L. Bargion. There were also three branch houses represented, to wit: Washington Electric Supply Company of Spokane, Washington, represented by Mr. Bargion, Western Electric Company of Salt Lake City, represented by D. J. Butts, and Marshall-Wells Hardware Company of Spokane, Washington, represented by Mr. Smith.

The meeting was also important for two reasons. First, it was the annual meeting of the Pacific Coast Division, and election of officers, and secondly, there were present at the meeting the General Secretary of the Association, Franklin Overbagh, and the General Counsel, Thomas M. Debevoise.

Mr. Overbagh and Mr. Debevoise try to attend at least one meeting of the Pacific Coast Division every year, and the members of the Division consider that these pilgrimages made at some sacrifice by the general officers are exceedingly important, viewed with respect to the success of the Association.

The election of officers resulted in the selection of Samuel H. Taylor of the Electric Railway & Manufacturers' Supply Company as chairman, Albert H. Elliott as secretary, and T. E. Bibbins of the Pacific States Electric Company as the member of the general executive committee from the division.

Mr. C. C. Hillis, in retiring from the chair, made a very graceful speech introducing Samuel Taylor as one of the original babies of the division who had advanced to lusty manhood, and was now sufficiently full grown to qualify on association matters as chairman of the association. Mr. Taylor, in accepting the chair, did not deny the soft impeachment and immediately began to co-operate by ordering for the whole crowd, something you cannot find in some prohibition states with a powerful magnifying glass.

At the open meeting with the manufacturers the paper of Mr. W. L. Goodwin on Co-operation between Contractor and Jobber, was read and Mr. S. V. Walton also read a paper upon the subject, and the general counsel of the association, Thomas M. Debevoise, delivered an address of which some very good advice was given to all those present.

The usual golf dinner was held on Saturday night, presided over by the inimitable Charley Wiggins. Whether it was the impending gloom or the farewell to Billy Goodwin or just natural inspiration, wit and fun flew fast and furious for two short hours.

The several cups were presented as follows:

The Manufacturers' Trophy, a large silver bowl that had been contested for by the manufacturers and jobbers for the past year and won by the manufacturers had its final competition for permanent ownership at this meeting. It was won by R. J. Davis of the Century Electric Company. Net score 87. H. E. Sanderson had the honor of the presentation. Pure Irish wit (reflected) gave flavor to his happy remarks and Mr. Davis responded in his usual graceful way.

William L. Goodwin

C. C. Hillis, presented the Pass & Seymour and Turner Trophy to F. N. Averill, who won on a net score of 96.

W. L. Goodwin and C. B. Hawley had the honor of presenting to Judge Debevoise the old copper cup and the Del Monte Cup. Each carried the fun just a little farther than the last, so that when Judge Debevoise responded to the last prize there was little left unsaid.

Stanley Walton won the Central Station Cup and Miles Steel presented it to him. That's all.

Albert Elliot delivered the farewell address to Mr. Goodwin, who is leaving for New York to continue in a broader field the great work of co-operation that he has been engaged in for several years among the jobbers, contractors, manufacturers and central stations. Mr. Elliot's heart was in his talk and while his language is always beautiful, this speech must be recorded as the master-piece of his life. Mr. Goodwin responded very happily.

At a recent meeting of the Socket Club Mr. Goodwin was presented with a very handsome open-face gold watch, with the following inscription engraved on the case:

"Presented to Bill Goodwin from the Socket Club, Bill Berry, Bob Davis, Charley Hillis, George Harris, George Holberton, Brad Squires, Sandy Sanderson, Charley Wiggins, Tracy Bibbins."

Those in attendance were:

Alvord, R. M., General Electric Co., San Francisco.
Averill, F. N., Fobes Supply Co., Seattle.
Airey, F. J., Pacific States Elec., Los Angeles.
Allen, H. H., Landers-Frier Co.
Anderson, S. B., Pacific States Electric Co., San Francisco.
Aspenwall, C. V., Westinghouse Elec. & Mfg. Co., Seattle.
Bibbins, T. E., Pacific States Electric Co., San Francisco.
Byrne, Harry, North Coast Elec. Co., Seattle.
Butts, D. J., Western Electric Co., Salt Lake.
Baker, C. G. A., Baker-Joslyn Co., San Francisco.
Berry, W. S., Western Electric Co.
Bargion, F. L., Montana Electric Co., Butte.
Bowers, N. A., Electrical World, San Francisco.
Burger, T. E., Western Electric Co., Los Angeles.
Case, J. O., General Electric Co., Los Angeles Cal.
Debevoise, T. M. New York.
Davis, R. J., Century Electric Co., San Francisco.
Elliot, A. H. San Francisco.
Fagen, F. D., General Electric Co., San Francisco.
Folland, R. S., Capital Electric Co., Salt Lake.
Greenfield, Mr., H. W., Johns-Manville Co., San Francisco.
Goodwin, W L., General Electric Co. San Francisco.
Gregory, S. B., Arrow Electric Co., San Francisco.
Hall, C. B., Illinois Electric Co., Los Angeles.
Hillis, C. C., Electric Appliance Co., San Francisco.
Hoxie, H. H., Electric Ry. & Mfrs. Supply Co., San Francisco.
Hawley, C. B., and wife, Intermountain Elec. Co., Salt Lake.
Harris, D. E., Pacific States Electric Co., San Francisco.
Hartzell, H. F., Baker-Joslyn Co., San Francisco.
Holabird, R. D., Holabird-Reynolds Electric Co., San Francicso.
Moody, A. S., General Electric Co., Portland, Ore.
Murray, F. H. National Carbon Co., Los Angeles.
Morris J. G., Westinghouse Elec. & Mfg. Co., Los Angeles.
McDonald, R. F., Holabird-Reynolds, Oakland.
Manchester, J. C., Electric Specialties Co., San Francisco.
Nylen, A. H., Gilson Electric Supply Co., Oakland.
Newbert, L., Pacific Gas & Electric Co., San Francisco.
Overbagh, F., Chicago, Ill.
Oakes, R. E., Ever Ready Works of National Carbon Co., S. F.
Pomeroy, J. G., Los Angeles, Cal.
Quick, P. V.
Reynolds, D. L., Holabird-Reynolds Co., Los Angeles.
Russell, S. P., H. W. Johns-Manville Co., San Francisco.
Smith, W. E., Marshall-Wells Hardware Co., Portland.
Sanderson, H. E., Bryant Electric Co., San Francisco.
Steel, M. F., Benjamin Electric Co., San Francisco.
Strong, E. B., Journal of Electricity, San Francisco.
Squires, H. B., San Francisco.
Taylor, Samuel H., Elec. Railway & Manufacturers' Supply.
Vandegrift, J. A., National Lamp Works of G. E., Oakland.
Walton, S. V., Pacific Gas & Electric Co., San Francisco.
Wurfel, W. C., Westinghouse Lamp Co., San Francisco.
Wiggin, C. E., Dunham, Carrigan & Hayden Co., San Francisco.
Young, Garnett, Telephone & Elec. Equip. Co., San Francisco.
Yost, H. F., Trumbull Electric of San Francisco.
Zorn, F. J., Pacific States Electric, Seattle.

Southwestern Electrical and Gas Association.

The thirteenth annual convention of the Southwestern Electrical and Gas Association will be held April 26, 27 and 28, 1917, at Dallas, Texas. A preliminary programme will appear in these columns at an early date.

Oregon Society of Engineers.

The Oregon Society of Engineers held its regular monthly meeting Friday evening, January 19, 1917, in the ladies' dining room of the Portland Chamber of Commerce, Portland, Oregon. Philip Dater, third vice-president, presided. The constitutional amendment was passed to limit the president's term of office to one year, and not make him eligible for immediate re-election. Geo. E. Reed, presented a paper on the "Mechanical Equipment of Buildings." Jay R. Keller presented a paper on "The Selection of the Proper Type of Heating Plant for Different Buildings." The attendance was forty.

California Association of Electrical Contractors and Dealers.

A special meeting was held by the California Association of Electrical Contractors and Dealers at Solari's Restaurant, in San Francisco, as a continuation of the fourth quarterly meeting held January 19th, in which the jobbers had the floor. This meeting was the contractors' and dealers' reply to the jobbers, and many good points were brought out with the ultimate outcome that plans for closer co-operation and enlarged spheres of work were outlined. Those who participated in the speaking were: H. C. Reid, E. E. Brown, M. L. Scobey, W. D. Kohlwey, George Sittman, F. C. Newberry, George Brouillet, J. C. Hobrecht, Frank Kenny, F. E. Decker.

Joint Meeting of Portland Section of N. E. L. A. and A. I. E. E. With the Oregon Society of Engineers.

The regular semi-monthly luncheon of the local sections of the A. I. E. E., N. E. L. A. and Oregon Society of Engineers was held in the orange room of the Oregon hotel, at noon Wednesday, January 10th. Paul Lebenbaum acted as chairman and A. H. Babcock, consulting electrical engineer for the Southern Pacific Company, San Francisco, gave a talk on "The National Reserve Corps of Engineers." The attendance was seventy-six.

The bi-weekly luncheon of the local sections of the A. I. E. E., N. E. L. A. and Oregon Society of Engineers was held Wednesday noon, January 17, 1917, in the Orange Room of the Oregon Hotel, Portland, Oregon. E. F. Whitney was chairman and the entertainment was under the direction of the General Electric Company. A paper prepared by W. D. B. Dobson, secretary of the Portland Chamber of Commerce, was read by W. L. Lines on "The Industrial Activities of the Northwest." An electric flatiron and a radiant heater were given away as prizes. The attendance was forty-six.

San Francisco Electrical Development and Jovian League.

The January 17th meeting was given over to a consideration of the extensive improvements being made on San Francisco's waterfront, under the direction of the State Board of Harbor Commissioners. Mr. J. J. Dwyer, president of the board was the speaker of the day and graphically told of the completed work and of the work under construction. He said that San Francisco was now equipped with piers which could accommodate the largest ship that could pass through the Panama Canal, and further stated, that from the experience of the engineers it seemed as though the concrete pile, which have been developed to a length of 106 ft, was proving the most satisfactory in the pier sub-structure work.

President Newbert of the League announced that plans were under way for the erection of a League Lecture Bureau which would undertake to supply speakers and lectures on electrical subjects for the public schools, clubs, etc., as demands might be made from time to time for such assistance.

The meeting of January 24 proved to be one of the most interesting and instructive of the long list of gatherings ever held by this organization. William Kiefer, general agent of Wells, Fargo & Company, San Francisco, gave a talk on building up new outlets for business endeavor which will long linger in the minds of all who heard him.

Portland Sections of N. E. L. A. and A. I. E. E.

The regular mid-season meeting of the Portland Sections of the A. I. E. E. and the N. E. L. A. was held Tuesday evening at the Multnomah Hotel, January 9th. J. C. Henkle, was chairman of the meeting. Miss Edna Groves, supervisor of domestic science, Portland public schools, gave an address on "Home Economics Electrical." Refreshments of ice cream and cakes and cookies were served after the address, all of the pastry being cooked electrically. A display was made of washing machines, ranges and various other home electrical appliances. Several others present joined in the discussion, including Messrs. Clarence R. Young and J. E. Davidson of the Pacific Power & Light Company. Miss Lillian Tingle of the Oregonian, also told of her personal experience with electric cooking and highly recommended it. Geo. W. Bowen of the Northwest Electric Company, and A. C. MacMicken of the Portland Light & Power Company, both gave a short talk on electric ranges and cooking.

The meeting was not restricted to the men but included wives, friends and sweethearts, consequently this program was arranged with special interest to the ladies.

After the refreshments, dancing was enjoyed until midnight and music was furnished by an excellent orchestra. The attendance was two hundred twenty-five.

Meeting of the Electrical Jobbers, Contractors and Dealers' Association.

Held at the Palace Hotel, San Francisco, January 19th, was one of the most successful gatherings that the association has ever had. One hundred and twenty men from all branches of the inustdry were present. After a very enjoyable dinner, Frank Sommers was called upon by the chairman of the meeting, C. B. Kenny, to welcome every one present. R. D. Holabird read an interesting paper on the classification of electrical jobbers with an explanation of the discounts used by jobbers. D. E. Harris spoke on providing stocks and rendering service stating that there was $1,000,000 worth of stock available to the contractors at any time without any risk on their part. Cass Gilson told how the Mazda lamps were paying the rents of a good many dealers. C. E. Wiggins told how the jobbers and central station men should co-operate on the Mazda lamp business which is profitable to all. Mr. H. H. Hoxie told of the advantages of the electric range to the dealers and central station men. Mr. W. S. Berry told what the jobbers have done in a direct way to further the interests of the dealers. C. C. Hillis explained the financial side of co-operation work between the jobber and contractor and showed how any company was losing money on the small orders. L. Levy explained the situation from the retailers' standpoint. C. F. Butte read a paper which is published in this issue on the contractors' business methods, and A. H. Elliot, A. Yongholm, W. S. Bray gave interesting talks on Trade Acceptances. The program was concluded by short talks from Stanley Walton, Henry Holland, H. C. Reed and R. M. Alvord on co-operation.

UTILITY COMMISSION NOTES.

Notes of Arizona Corporation Commission.

All railroads in the State of Arizona are to file with the commission a statement of new mileage constructed by each company within the state from January 1, 1916, to December 1, 1916, showing whether construction was new track, siding or double-track paralleling main line, also location of same. Also estimate of additional new track constructed between January 1, 1916, and December 31, 1916.

In the matter of the application of the Northern Arizona Telephone Company for authority to sell its property, rights and franchises to the Arizona Electric Telephone Company, and in the matter of the application of the Arizona Electric Telephone Company for an order or decree of authorization to purchase and acquire all of the property, rights and franchises of the Northern Arizona Telephone Company, and to issue capital stock at par in payment therefor, the commission has granted the request.

In the matter of the application of Walapai Lighting & Power Company for a certificate of convenience and necessity, the commission has denied the request.

In the matter of the application of the Pacific Gas & Electric Company, a corporation, for an order authorizing the issue of bonds and debentures, the commission has granted permission to offer for sale sufficient bonds and debentures to reimburse the treasury of the company for the amounts expended for extensions, additions and improvements.

Notes of Utilities Commission of Idaho.

In the matter of the application of the Project Mutual Telephone & Electric Company, a corporation, for a certificate of convenience and necessity, to engage in the distribution of electric power and current, the commission has granted the request.

Sandpoint Water & Light Company, a corporation, complainant, vs. Humbird Lumber Company, a corporation, defendant. It is hereby ordered that the above named defendant be and it is hereby granted to and including February 1, 1917, within which to answer or otherwise plead to the complaint of the complainant in this cause.

NEW COURSES IN UNIVERSITY EXTENSION OF INTEREST TO ENGINEERS.

Their day's work in factory or shop over, many San Francisco mechanics are resorting to the evening classes in machine shop practice which the University of California Extension Division is conducting at the Polytechnic High School, First avenue and Frederick street, San Francisco. A new machine shop class will be organized at 7 o'clock Wednesday evening, January 17, to meet every Wednesday from 7 to 9:15 p. m. Those who complete this ten weeks' course may then take an advanced course dealing with milling machine practice, gear cutting, milling machine calculations, tool making and tempering, etc.

The beginners will be taught how to do cylindrical turning, taper turning, screw cutting, laying out and drilling holes, plain milling, etc. Men with special problems which they want to work out or special work to do will be given opportunities in these evening extension courses.

Three different courses for draughtsmen are being given by the University of California Extension Division during the half-year which began January 16, at the Polytechnic High School in San Francisco. An elementary course teaches the use of instruments, the making and reading of working drawings, and simple intersections. A second course in machine drafting deals with power transmission machinery, rivefed joints, couplings, clutches, belt and rope drives, etc. A third course deals with electrical design, including the laying out of circuits, the designing of transformers, generators, motors, etc. For those who have had training in algebra and trigonometry, a course will be offered in mechanics, dealing with the problems of structures, such as trams, cranes, and beams, and with the elements of hydraulics, acceleration problems in machinery, etc.

BOOK REVIEW.

Government Telephones. By James Mavor, Ph. D. Size 5 in. by 7½ in.; 164 pp.; no illustrations; cloth binding Published by Moffat, Yard & Company of New York City, and for sale at the Technical Book Shop, San Francisco, Cal. Price $1.00.

The author of this book is Professor of Political Economy at the University of Toronto. The book is concerned with the experience of Manitoba, Canada, in its relation to telephone problems. It is a compelling and fearless narrative of the true record of an American government in the management of a great commercial business. It tells what happened to the rates and what happened to the finances, what happened to the consumer and what happened to the taxpayer. It is essentially a vivid narrative of political intrigue and carries a lesson to every patriotic American.

In the United States we are all too prone to consider ourselves as constituting the only people that may properly style themselves as Americans. The recent growth in world progress now compels us to broaden our viewpoint and consider all Americans that occupy the mainland of the American continents.

This article or book viewed from this point of discussion, makes the book at hand of unusual interest to Americans as a whole, and in its discussion of a very live topic adds much to our present knowledge of a very knotty problem.

NEW BULLETINS.

The measurement of electrical energy, electricity meters, rates for electrical energy, is the subject matter of a recent bulletin of the University of Kansas, by Geo. C. Shead and C. A. Johnson.

"Fierro En Paz" (Iron in Peace) is the title of an interesting souvenir booklet just issued by the Dunham, Carrigan & Hayden Company of San Francisco, consummating sixty-seven years of business activity.

LATEST IN EVERYTHING ELECTRICAL

(The various university extension bureaus throughout the West are doing much in bringing rural communities in touch with the latest electric appliances. Below are briefly described an account of a traveling industrial exhibit, a new mammoth magnetic clutch and new conduit fittings for push button switches which represent interesting electrical advances since our last date of publication.—The Editor.)

TRAVELING INDUSTRIAL EXHIBITS.

The University of California extension division, bureau of visual instruction, has selected the products of the Interstate Electric Novelty Company as traveling exhibits, to be displayed in the public schools of California. It is interesting to know that these products, known as the "Franco" flashlights and batteries, were selected by the division. We pre-

Exhibit of University of California Extension Course in Visual Instruction

sent illustrations of the display board of both the flash-lights and batteries, each showing the different stages and progress of manufacture of the product, from the rough materials to the finished goods. Each article on the board is numbered and explanatory references are printed on the lower section of the board.

CONDUIT FITTINGS FOR USE WITH C-H PUSH-BUTTON SWITCHES.

Three new conduit fittings are shown in the accompanying illustration particularly adapted to C-H snap switches, Fig. 1 shows a C-H No. 7102 Surface Switch on a rectangular Crouse-Hinds fitting, and Fig. 2 shows a C-H No. 7108 round base switch installed on a standard round conduit fitting. Fig. 3 shows a C-H No. 7105 switch with special base installed on a standard Paiste taplet. The conduit fittings referred to may be used with any metal conduit of corresponding diameter and thread. The fittings are small, with a japanned or galvanized finish to match the finish of the conduit. The switches have the characteristic C-H push-button operation with a light button for closing the circuit and a dark button to open the circuit. In addition to being used on conduit systems, the switches may also be used on practically all kinds of wiring systems—wooden and metal molding, open wiring and concealed wiring. They are rated at 5 amperes, 125 volts, and 3 amperes, 250 volts, National

Fig. 1

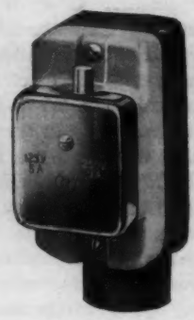


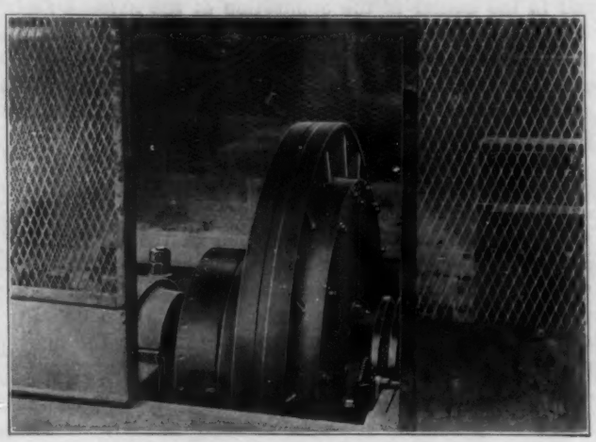
Fig. 2

Fig. 3

Electrical Code Standard, and made by The Cutler-Hammer Manufacturing Company of Milwaukee.

GOODYEAR RUBBER CO. HAS 2200 H.P. C-H MAGNETIC CLUTCH.

The largest magnetic clutch installed for rubber mill service has recently been furnished to the Goodyear Rubber Company, Akron, Ohio. This is a 78-inch clutch with a capacity of 2200 h.p. at 100 r.p.m. used on the rubber mill drive. The accompanying view shows the clutch installed. It is enclosed completely in the wire screen compartment. The clutch consists of a solid circular steel casting mounted on the mill end of the shaft. This member of the clutch carries imbedded in its periphery a single cylindrical magnet-



Mammoth Magnetic Clutch

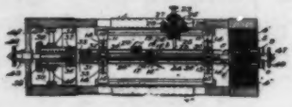
izing coil, the terminals of which are brought out to an ordinary pair of slip rings. Mounted concentrically with the coil and the outer periphery, is supplied an adjustable friction ring so that the metal faces of the driving and driven member do not come directly in contact with each other. This also serves the purpose of providing a permanent air-gap in the magnetic circuit.

WHAT WESTERN INVENTORS ARE DOING

(The dynamo-electric machine, the internal combustion engine and the wind motor still seem to occupy the attention of Western inventive talent. The method of revivifying and utilizing spent oxid described herein is of unusual interest. A by-product of lime and sulphur thus produced if economically brought about should prove of unusual importance on the Pacific Coast where the sulphur content of oil has in the past given considerable trouble in using crude oil for the manufacture of illuminating gas.—The Editor.)

1,211,770. **Micromagnetic Detector.** Frederick G. Simpson, Seattle, Wash.

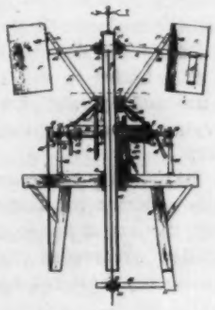
A wireless telegraph system, the combination with two suitably supported magnetizable reeds disposed at a suitable distance from and parallel with each other, of means for changing the natural and fundamental rate of vibration of each of the reeds, means for magnetically polarizing to a



desired constant degree one of the reeds, an electro-magnet disposed to extend lengthwise between the reeds, and adapted to be energized to attract the reeds each toward the other, a helix of insulated wire disposed to surround one of the reeds whereby electrical energy may be caused to change the magnetic condition of the reed, and a pair of movable electrical contact points associated with and adapted to be controlled by the reeds.

1,212,109. **Wind-Motor.** Ernest C. Rodwick, Santa Barbara, California.

A wind motor, a wind wheel including collars, means to slide one collar relatively to the other, arms pivoted at their inner ends on the slidable collar, wind blades mounted on the



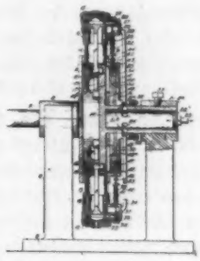
arms to rock on their own axis, arms pivoted on the second collar, and co-acting trip members on the second arms and on the blades to turn the latter on their axes by a sliding movement of the collar.

1,211,713. **Method of Revivifying and Utilizing Spent Oxid.** Emil B. Kinz, Oak Park, and Edson C. Wescott, Sacramento, Cal., assignors to Pacific Gas & Electric Company, San Francisco, Cal., a corporation of California.

The method of revivifying and utilizing spent oxid from gas works which consists in adding thereto unslaked lime and sufficiently hot water in a fluid form to extract the sulphur therefrom and separating from the oxid a soluble compound of lime and sulphur.

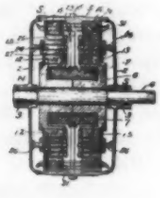
1,212,100. **Internal-Combustion Engine.** Herschel Oldham, Escondido, Cal., assignor of two-fifths to F. D. Hall, Escondido, Cal.

An internal combustion engine, the combination of a support having aligned bearings, a sleeve secured in one of the bearings, a casing mounted to turn relative to the sleeve, the sleeve extending through one side of the casing, a power shaft extending through the other bearing of the support and connected rigidly with the other side of the casing, cylinders mounted upon the casing, a piston slidably mounted within each cylinder, a piston rod secured rigidly to the piston,



an intake chest disposed adjacent each cylinder and adapted to communicate it therewith, an exhaust chest disposed adjacent each cylinder and adapted to communicate with it, a main cam plate within the casing and rigidly connected with the inner end of the sleeve, the piston rods engaging the main cam plate, an intake-controlling cam plate, and an exhaust-controlling cam plate mounted rigidly upon the sleeve within the casing, means for supplying an explosive mixture to the intake chests, mechanism actuated by the intake cam plate for delivering charges of explosive mixture from the intake chests to the cylinders, and mechanism actuated by the exhaust-controlling cam plate for discharging burnt gases from the cylinders.

1,211,617. **Dynamo-Electric Machine.** Alfons H. Neuland, San Francisco, Cal., assignor to Neuland Electrical Company, Inc., a corporation of New York.



A dynamo electric machine, means for producing a magnetic flux, a stationary element and a rotatable element adapted to be traversed by the magnetic flux, and a plurality of relatively movable elements arranged between the stationary element and rotatable element.

NEW ELECTRICAL DEVELOPMENTS

(A normal amount of new street lighting activity is recorded in new electrical development since the last issue of the Journal. The continued rumor of gigantic development of power sites along the Columbia with a view of irrigating some half million acres in the Horse Heaven region by pumping and in addition supplying power for railway electrification occupies the attention of the close follower of Western activity. In Southern California the municipal bond issue for taking over the local companies supplying the field has engrossed the attention in that district. Other interesting items may be gleaned from the following notes.—The Editor.)

FINANCIAL.

SEATTLE, WASH.—The superior court is asked to enjoin the issuance by the city of $390,000 in bonds for a municipal steam plant for the generation of electricity on Lake Union, and $60,000 for a water department pumping station and standpipes at Green Lake in two suits filed by Bruce C. Shorts of the law firm of Ballinger, Battle, Rulbert and Shorts as a taxpayer. Action is based on the contention that the city cannot issue the bonds without submitting them to the voters.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company is offering a new issue of first preferred 6 per cent stock. The new preferred stock is non-assessable and tax free, and is not subject to normal federal income tax. This stock has preference over $34,035,858 of common stock which has a present-day valuation of about $20,000,000.

LOS ANGELES, CAL.—When the proposed $12,000,000 power bonds are voted, and the distributing system of the Southern California Edison Company and the Pacific Light & Power Company taken over by the city, sufficient money will be set aside from the sale of power and paid into the city treasury by the power department to care for the interest and sinking fund not only of the new issue of $12,000,000 but all former power bond issues amounting to $10,000,000.

INCORPORATIONS.

ELMA, WASH.—The Elma-Matlock Telephone Company has filed articles of incorporation.

JEROME, ARIZ.—Articles of incorporation have been filed by the Oak Creek Power Company. The incorporators are O. S. Chick and Andres Nestaire of Cornville, Yavapai County. Capital, $750,000; principal place of business, Jerome, Ariz.

PHOENIX, ARIZ.—Articles of incorporation have been filed by the Hydro-Power & Irrigation Company with a capital stock of $1,000,000. The officers and directors are Lemon L. Osborn, R. L. Osborn and D. H. Osborn. The incorporators are: Frank Putzell and Ronald L. Osborn of Phoenix. The principal place of business in Arizona shall be Phoenix.

ILLUMINATION.

DOUGLAS, ARIZ.—The bid of the Douglas Traction & Light Company for the lighting of G avenue and Tenth street, viz., $14,750, has been accepted by the city council.

LOS ANGELES, CAL.—Bids are being received by the board of supervisors for installing an addition to the system of street lighting in the Verdugo lighting district.

CASA GRANDE, ARIZ.—As soon as preliminaries of receiving bids and making contracts can be finished work will begin on the municipal water and electric lighting plant.

SANTA BARBARA, CAL.—The city council has ordered lights to be placed at Los Olivos and Laguna streets, and at State and Mission streets.

KENDRICK, IDAHO.—The local electric light and power company is about to start work on the construction of a high tension transmission line to Moscow. The material for the work has been ordered.

SAN RAFAEL, CAL.—Mr. Kane, who has held the Novato lighting franchise for the past five years, appeared befor the board of supervisors, asking to have his franchise renewed.

FRESNO, CAL.—Bids are being received by the board of trustees for the installation of the electrolier lighting system upon "J" street from Inyo street to the southeast line of Los Angeles street.

BURBANK, CAL.—Bids have been called for by the board of trustees for the erection and constuction of ornamental street lights on Second street, otherwise known as San Fernando boulevard.

SAN FRANCISCO, CAL.—The office of constructing quartermaster, Fort Mason, Cal., has called for bids for installing an electric lighting system for the officers' quarters, Presidio, San Francisco.

MESA, ARIZ.—The town has made a formal offer of $113,000 for the purchase of the South Side Gas & Electric Company's plant. It is understood that this offer will be accepted if preliminaries are satisfactory.

SEATTLE, WASH.—The Pacific Lamp & Supply Company has been awarded the contract for the 450,950 electric lamps, which the light department will need during 1917, by the board of public works at the cost of $100,000.

INDEX, WASH.—The city council has instructed the city attorney to frame an ordinance authorizing an election for a vote on the construction of the proposed $20,000 municipal lighting plant in this city. Plans for the project have been completed by Consulting Engineer G. N. Miller, of Seattle.

MONTEBELLO, CAL.—The board of trustees has authorized the publication of a notice to sell the franchise to lay, construct, maintain, use and operate pipes, pipe lines, mains, and conduits for carrying and distributing gas to be used for heat, light and power.

SACRAMENTO, CAL.—The Electrical Supply Company has been awarded the contract for installing electroliers to be placed in front of the court house on its bid of $3565. The contract for lighting fixtures at the nurses' home and surgical ward at the county hospital has been awarded to J. C. Dolan, for $978.

REDONDO, CAL.—At a meeting of the board of trustees the city clerk gave the result of the straw vote held for installation of ornamental lighting system in Diamond street. The result showed that electricity was the favorite and the petition was granted. The city engineer was instructed to take the necessary steps for the improvement.

WOODLAND, CAL.—Foremost of the 1917 plans is a lighting system for the entire city. A distinctive feature of this lighting system is to be a white way line of electroliers along Main street from the Southern Pacific tracks to Cemetery avenue, with at least four lights to the block.

EVERETT, WASH.—Word was received here that G. N. Miller of Seattle has been granted a special commission by the council of Index in Snohomish County, to prepare plans and engineering data for the construction of a municipal lighting plant. The plant will be financed by a bond issue, and work on the plant is expected to begin in three months.

WHITTIER, CAL.—The contract for the erection of ornamental lighting posts for Philadelphia street has been signed and John W. Wilson of Los Angeles will have charge of the work. The posts are of reinforced concrete and similar to ones in use in Anaheim and Santa Ana. The contract includes wiring, conduits and lamps.

CHICO, CAL.—The Western Gas & Electric Appliance Company has been awarded the contract for the city's part of the new electrolier system, which is to be installed as soon as the materials can be shipped from the East. It is probable the work will start early this month and be completed in about six months. The contract price is $1.24 per front foot, including a light in the center of the city park.

TRANSMISSION.

JEROME, ARIZ.—Construction of an electric generating plant with a capacity of 10,000 h.p. will be commenced at Clarkdale within the next few days by the Arizona Power Company.

KINGMAN, ARIZ.—The storm here played havoc with the Golconda power line of the Desert Power & Water Company of Kingman, the long distance line of the Arizona, California and Nevada Telephone Company were also put out of commission.

PALO ALTO, CAL.—The board of public works recommended to the city council that an election be held at an early date to vote on the issuance of bonds in the sum of $75,000 for the purchase of two additional Diesel engine units for the power plant.

HONOLULU, HAWAII.—Plans are being considered by local Japanese and Chinese business men whereby the next Hawaiian legislature will be petitioned to grant them a franchise for the manufacture and sale of electricity for lighting and other purposes.

RIVERSIDE, CAL.—The South Sierras Power Company is rushing repairs to its great steel tower line in Inyo County, which suffered extensive damage during the recent storm. The total damage in Inyo County was $100,000, and the Sierras Company was the heaviest loser.

CROCKETT, CAL.—For some months the Great Western Power Company has been working for the betterment of its service in this county. They have purchased a 9 acre tract on the hill west of Valona. On this land an electric substation will be built similar to the one at Clayton.

STAYTON, ORE.—The Crown Mining & Milling Company, located near Elk Horn has been purchased by a California man. The new owner will install a mill on the Little North Fork of the Santiam River soon. The mill is to be operated by electricity and constructed at the cost of $20,000.

PRESCOTT, ARIZ.—The contract has been awarded and grading started for the auxiliary electrical plant for the Arizona Power Company to cost approximately $1,000,000. The plant will have a capacity of 10,000 h.p. and will be connected with lines radiating from the company's Fossil Creek works. The site of the plant is on the Verde River about 3 miles above Clarksdale.

PORTLAND, ORE.—The Molalla Electric Company of Oregon, operating electric light and power franchises in Canby, Hubbard, Aurora, Barlow and Donald, and the surrounding rural districts, having stock valued at close to $75,000, will change ownership very soon, as a contract has been drawn up for the sale of the property and papers for the transfer of the stock are in readiness for the negotiations, according to the attorneys. Miles C. Moore, banker of Walla Walla, is the owner of the company and E. R. Robinson, manager of the Jim Creek Light, Water & Power Company, will buy out his power plant, situated near Canby on the Canby River, and transmission lines. Robinson is a former governor of Washington and president of the State Association of Electrical Engineers. His power plant is located at Arlington, Wash.

TRANSPORTATION.

FULLERTON, CAL.—The Pacific Electric Railway Company has applied to the board of trustees of this city for a franchise.

GRASS VALLEY, CAL.—The board of supervisors have granted a right of way to the Empire Mines Company for an electric railroad from the Empire to the Pennsylvania mine, near Grass Valley.

SAN DIEGO, CAL.—The common council has granted to the Los Angeles & San Diego Beach Railroad Company a franchise to construct, operate and maintain a double-track street railway within the city limits.

OXNARD, CAL.—The Ventura County Railroad Company is having a survey made with the expectation of extending its lines to the beach. The extension will be made either from Patterson Ranch or from South dump through the Lehmann ranch.

PETALUMA, CAL.—The Northwestern Pacific Railroad has asked and received permission to lay 5 tracts across Fourth street in Point Reyes. It is generally believed that this means the extension of the electric line from Manor to Point Reyes station.

VISALIA, CAL.—The Visalia Electric Railroad Company is planning still further improvements, it is declared, among which is the decision to use the new gas-electric motor for passenger and freight service on the new extensions on the east side, and eventually into Visalia, instead of the overhead trolley system.

LOS ANGELES, CAL.—The cost of a group of new buildings to be erected for use of the Pacific Electric Railway Company at Torrance will be about $500,000. It is planned to erect about 14 buildings, which will cover an area of approximately 30 acres. Among the buildings will be a machine shop, paint shop, freight shop, blacksmith shop, power house, storage and office buildings.

LOS ANGELES, CAL.—The Pacific Electric Company has filed in Santa Ana an application to condemn for right of way purposes certain lands between La Habra and Fullerton, stating that it is the intention of the company to extend its lines to connect up the Los Angeles-Riverside gap of the Whittier-La Habra line and to build an additional line from La Habra to Santa Ana. It is probable that the cost of the new line will reach $50,000 per mile.

WENATCHEE, WASH.—It is reported that the Milwaukee R. R. Company will spend $150,000,000 in the Columbia River basin, if the bill, on which F. K. Lano is now working for the leasing of water from streams and water power sites is passed. There is a probability of an electric line being built from Priest Rapids to tap the Wenatchee and Okanogan valleys. Other phases of the big project are said to include the development of 400,000 acres of land along the Columbia by a pumping system for irrigation.

SANTA ANA, CAL.—A double track line from Los Angeles to Santa Ana via Whittier, La Habra, Fullerton, Anaheim and Orange is claimed as one of the plans of the Pacific Electric Railway Company, and it is said that plans are already prepared for the extension. Whittier boosters have staretd a movement to have the Whittier line extended southward to join the La Habra line. The completion of the rumored extension south to Santa Ana would give this city two direct lines to Los Angeles.

TELEPHONE AND TELEGRAPH.

POMONA, CAL.—The Pomona Valley Telephone & Telegraph Union plans to erect a two story brick building on Louisa street, which will cost about $21,293.

PHOENIX, ARIZ.—The Mountain States Telephone & Telegraph Company are constructing a new toll line that will go from here to points in the northern part of the state.

BOISE, IDAHO.—E. H. Dewey of Nampa, owner of the Evening Capital News, has purchased a three-story building, formerly owned by the Independent Telephone Company.

ANTIOCH, CAL.—J. McBirney, who has charge of the engineers' department of the Pacific Telephone & Telegraph Company, stated that the company would make an expenditure of about $13,000 in providing very latest improvements.

TACOMA, WASH.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for telephone and power transmission lines between the Pacific Coast Torpedo Station, Keyport, Wash., and the Puget Sound Navy Yard, also an electric transmission line from the Olympic Power Company's pole line to the radio building.

LOS ANGELES, CAL.—Approval has been given by the council to the proposed ordinance and agreement for the transfer of the Home Telephone Company's franchise to the Southern California Company. It is stated that it will require about a year to fully construct the physical interchange that will take care of the two companies, and the cost will be about $750,000. It will be necessary for the Southern California Company to enter into an agreement immediately to extend service to the Palms, San Pedro, Wilmington and adjacent territory.

IRRIGATION.

LINDSAY, CAL.—The Strathmore Irrigation district's loss last week in the high water washout on construction work on Kaweah was close to $1000.

COLUSA, CAL.—Directors of the Cheney Slough Irrigation Company have awarded the contract for the 26 in. pump and 200 h.p. motor to G. W. Tibbets.

SUSANVILLE, CAL.—Organization of the Long Valley Creek Irrigation District will be perfected early in January. Water in this district will be distributed over an area of approximately 34,000 acres.

FAIROAKS, CAL.—Fairoaks residents have signed a petition asking the supervisors to call an election for the formation of a Wright Irrigation District. The petition will be presented to the board on February 5th. The proposed district will include 3600 acres. The cost of the project is estimated at $125,000.

MERCED, CAL.—The Crocker-Huffman Land & Water Company has commenced the construction of a $10,000 spillway at the end of the Livingston Canal of the company's irrigation system and is preparing to establish a second construction camp in the Livingston vicinity to commence rebuilding the canals of the system there.

PORTLAND, ORE.—The construction of the proposed Horse Heaven irrigation district, which contemplates the reclamation of 300,000 acres of land between the Yakima and Columbia rivers in eastern Washington, would cost, complete, $24,553,438, according to a report made by O. Laurgaard, consulting engineer to the directors of the district.

PORTLAND, ORE.—A majority of the members of the legislature were present at the Oregon Irrigation Congress when it opened at the Imperial Hotel, and many important matters were discussed directly affecting irrigation. The members of the legislature were present primarily to study the irrigation situation and to learn from the congress its recommendations for irrigation laws.

ANDERSON, CAL.—At the mass meeting of Anderson-Cottonwood Irrigation District land holders, the only definite action taken was the adoption of a resolution asking the legislature to amend the Wright law, under which the district is organized, to permit the voting of a second bond issue before all funds raised by the first bond issue have been expended. Engineer Means declared the district had received full value for the money already expended, but stuck to his estimate that it would require $488,000 additional to complete the project, as originally planned.

PARADISE, CAL.—The tentative date for the $350,000 Paradise Irrigation District bond election has been set for February 7. The district proposes to build a storage dam on Little Butte Creek and install a pipe system for the distribution of water. The plans for the system have been approved by the State Engineer's office. William H. Lewis, president of the Lewis, Wiley & Morse Construction Company, has just finished inspecting the dam and reservoir site of the Paradise Irrigation District for the purpose of placing a bid on the construction work.

SACRAMENTO, CAL.—The Yolo Water & Power Company, which controls some 335 miles of main canals and laterals in Yolo County, distributing water taken from Clear Lake, 100 miles away, is preparing for a large increase in the acreage planted to rice and small orchards generally, according to W. G. De Celle, who at the time of the reorganization of the company last September was made president and general manager. The company is increasing its irrigating capacity at every opportunity and last year took over a number of privately owned ditches, developing them into major canals with large capacities and connected with the main canal.

VISALIA, CAL.—The second step in the big water suit of the Tulare Irrigation District against the newly created 2,000,000 Lindsay-Strathmore Irrigation District, which seeks to take water from the Kaweah River basin was recorded when Superior Judge W. B. Wallace granted the defendant corporation until January 15th to prepare and file its answer. Recently the court overruled the demurrer of the defendant and ordered the case to trial, thus deciding in favor of the plaintiff on the first point. The case involves the right of one district to come into an entirely different water basin and take water therefrom, and will be carried through to the highest court.

BOISE, IDAHO.—Since the inauguration of the new state land board in Idaho's state government things have been happening at a rapid rate. The board also started in on a campaign to clean up numerous projects which have been hanging fire. Summarized, the board's actions follow: Indefinitely extended the time for the settlers on the Twin Falls-Oakley project in which to make final proof to the government, which virtually gives the settlers a new lease of life; instructed the attorney-general to bring action immediately in the state courts to secure a receiver for the Twin Falls-Salmon River irrigation project; instructed the attorney-general to bring suit on the bonds of the King Hill, the King Hill Extension and the Blaine County Irrigation Company projects for failure to complete work; took similar action with regard to the Big Lost River Irrigation Company, which put up a $75,000 bond; directed the Blaine County Investment Company to put up a bond equal to 5 per cent of the construction work; paved the way for cancellation of the Hedsted project in eastern Idaho.

REDDING, CAL.—An appropriation of at least $2500 with which to pay expenses of a representative to appear before congress in the interests of the Pit River project, will be asked of the Shasta County supervisors. The request for funds will be made by C. F. Smith, secretary of the Shasta County Promotion and Development Association, which organization will ask congress to approprite $100,000 for a final survey of the Pit River project. The Pit River project contemplates the irrigation, the development association claims, of approximately 60,000 acres east of the Sacramento River, and east and northeast of Redding. Hopson's report says the area includes about 55,000 acres. The plan is to take water from the Pit River by means of a high diverting dam and tunnel piercing the ridge that divides the Pit River basin from those of the small eastern tributary stream of the Sacramento lying immediately to the south. Hopson's estimate is that the total cost of the proposed project would be $3,417,000.